United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
the Missouri Agricultural
Experiment Station

# Soil Survey of Macon County, Missouri

# How To Use This Soil Survey

## General Soil Map

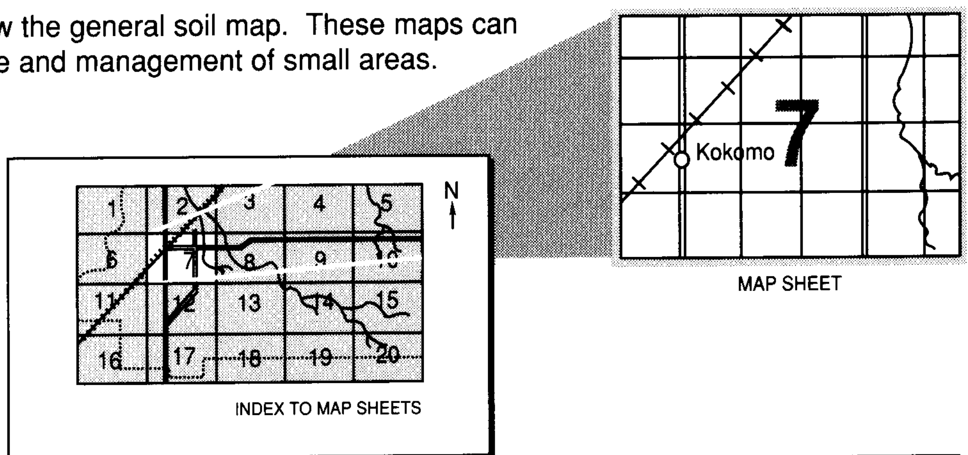
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

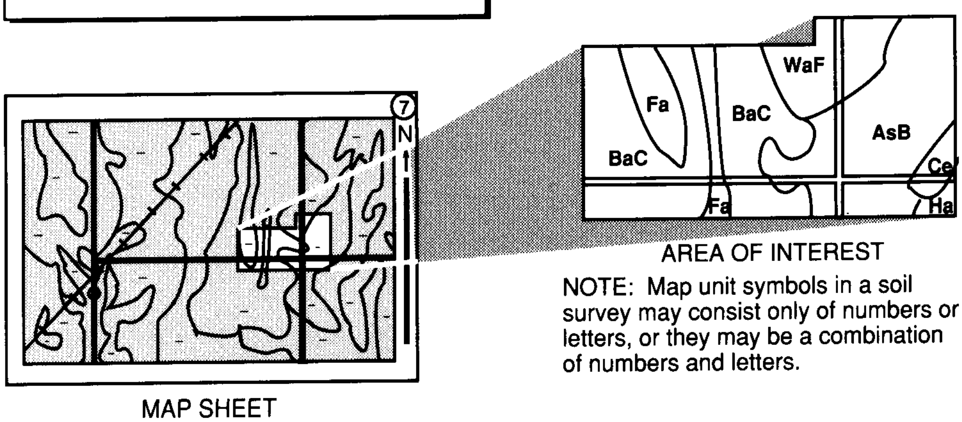
## Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.




Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.




NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Missouri Agricultural Experiment Station, and local agencies. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1984 to 1989. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1990. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources provided soil scientists to assist with the fieldwork. Additional funding was provided through the Macon County Soil and Water Conservation District by the County Commission, private businesses, and individuals. The survey is part of the technical assistance furnished to the Macon County Soil and Water Conservation District.



**Cover: Second-growth alfalfa in an area of Mexico silt loam, 1 to 3 percent slopes. A crop rotation that includes pasture and hay crops minimizes water erosion.**

# Contents



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# Foreword

This soil survey contains information that can be used in land-planning programs in Macon County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Russell C. Mills
State Conservationist
Soil Conservation Service

# Soil Survey of Macon County, Missouri

By Henry J. Ferguson, Soil Conservation Service

Fieldwork by Henry J. Ferguson, Dennis K. Potter, and Carol A. Bartles, Soil Conservation Service; Michael L. Chalfant and Sammy J. Grimes, Missouri Department of Natural Resources; and Felix A. Ogunsakin, Macon County Soil and Water Conservation District

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Missouri Agricultural Experiment Station

MACON COUNTY is in the northeastern part of Missouri (fig. 1). It is about 50 miles west of the Mississippi River and 50 miles north of the Missouri River. It has a total area of 520,026 acres, or about 812.5 square miles. In 1980, the population of Macon County was 16,700 *(14)*. Macon, the county seat, is in the east-central part of the county. It had a population of 5,680 in 1980.

This survey updates the soil survey of Macon County published in 1913 *(18)*. It provides additional information and larger maps, which show the soils in greater detail.

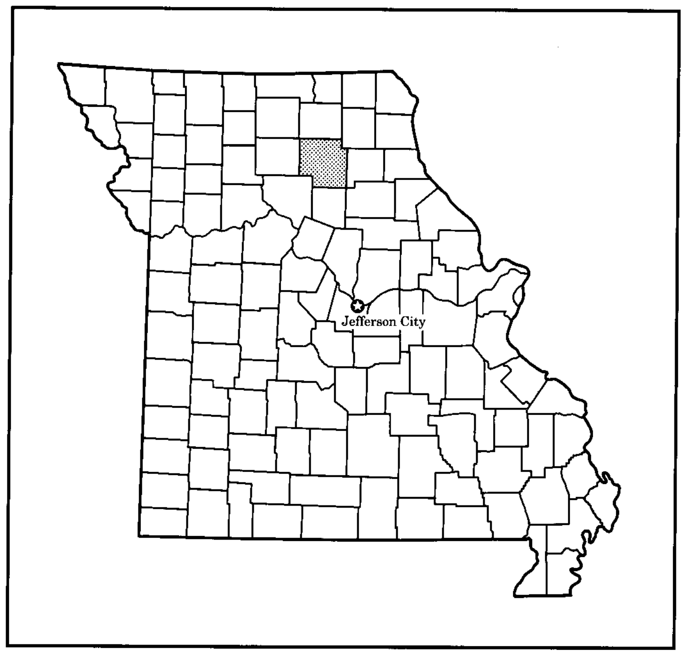


**Figure 1.—Location of Macon County in Missouri.**

## General Nature of the County

This section gives general information about the county. It describes climate; natural resources; history and development; farming; and physiography, relief, and drainage.

### Climate

The consistent pattern of climate in Macon County is one of cold winters and long and hot summers. Heavy rains occur mainly in spring and early summer, when moist air from the Gulf of Mexico interacts with drier continental air. Snow generally falls every winter and often lasts a few weeks. The annual precipitation is normally adequate for the growth of corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Macon, Missouri, in the period 1951 to 1984. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 28 degrees F and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at Macon on January 10, 1982, is -22 degrees. In summer, the average temperature is 75 degrees and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred on July 15, 1954, is 112 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, about 26 inches, or about 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 21 inches. The heaviest 1-day rainfall during the period of record was 5.2 inches at Macon on July 1, 1958. Thunderstorms occur on about 53 days each year.

The average seasonal snowfall is about 24 inches. The greatest snow depth at any one time during the period of record was 18 inches. On the average, 15 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally but are local in extent and of short duration. The amount and extent of damage are variable. Hailstorms sometimes occur in scattered small areas during the warmer part of the year.

## Natural Resources

Coal is an important resource that influenced the development of Macon County. From 1886 to 1965, Macon County produced 43,973,260 tons of coal *(5)*. Coal deposits were first extracted with shaft mining methods, and shafts to a depth of 185 feet or more were not uncommon. By 1937, the coalbeds that could be reached easily had been depleted. The development of efficient, large-bucket shovels led to an increase in surface-mining activities *(5)*.

Several extensive surface mines were developed in the southern part of the county. Because of the depth and the thin nature of the remaining natural coal deposits, however, surface-mining activities in Macon County have been abandoned.

Sandbars have developed along the channelized Chariton River. These sandbars currently serve as a source of sand for roads and concrete.

## History and Development

Michael L. Chalfant, soil scientist, Missouri Department of Natural Resources, helped prepare this section.

The earliest inhabitants of the survey area were Indians, who hunted and camped along the major streams. Burial mounds, which were generally constructed from the upper horizons of the Gorin soils, provide evidence of the Indians' presence. The Missouri, Fox, Sauk (Sac), and Sioux were among the tribes encountered by early explorers and trappers, who traveled up the Chariton River in pirogues, or boats hewn from cottonwood trees *(7)*. The Indians constructed a stone fording bridge across the Chariton River. This bridge was used by the early settlers to trap fish and was later modified into the dam associated with Hammock's flour mill *(4)*.

In 1827, the first European settlers, the James Loe family, arrived in the area. They settled just south of the present town of Callao *(7)*. At the time of settlement, large tracts of hardwood forest grew on the sloping Winnegan and Keswick soils. Tall, native grass prairies were extensive and highly productive, and the grasses were well adapted to the climate and soils of the area *(18)*. This environment provided a variety of resources for the pioneers. Black bear, elk, white-tailed deer, bison, turkeys, prairie chickens, quail, and beaver inhabited the forests and prairies *(7)*.

Most of the early settlers came from the area that includes present-day Howard and Randolph Counties. These settlers previously had migrated to Missouri from Kentucky and Virginia *(8)*. The influx of settlers brought about many changes. As a result of treaties and because of pressure from the increasing population, the Indians were forced to move from the area. Also, many Indians died from diseases introduced by the European immigrants. As the settlers began to farm the land, the native vegetation was removed and the soils became susceptible to erosion.

Macon County was organized in 1837. The first county seat was the hamlet of Bloomington. The town of Macon, which was originally called Hudson, became the county seat in 1863. The population of Macon County in 1837 was more than 5,000 *(3)*. The town and the county were named for Nathaniel Macon, a leading statesman *(8)*.

The early settlers established their homes in areas of Gifford and Chariton soils on the higher stream terraces or in areas of Gorin and Winnegan soils on upland ridges adjacent to streams. These locations provided the settlers with easy access to lumber, water, and shelter. The nearby prairies were used as open range for livestock and were not settled initially because of the difficulty of working the sod. Once the sod was broken out, however, the settlers found that the upland prairie soils and the bottom-land soils were very productive. They planted tobacco, corn, winter wheat, rye, and oats. Tobacco was the principal cash crop, and cattle and hogs were the chief source of revenue. The native grasses were well adapted to the landscape associated with Armstrong, Purdin, Bevier, and Zook soils and to the climate of the county. More than 50 varieties of native grasses grew in Macon County, and cattle were allowed to graze on the open range. Timothy and orchardgrass were introduced as cool-season grasses for early spring, late fall, and winter feeding. A decline in soil fertility was noted by 1911, and thus attention was given to growing more legumes and incorporating more organic matter into the soil *(18)*.

In 1860, the Bevier coal vein was discovered by a well digger. During the period from 1910 to 1919, Macon County led the state in coal production. The annual output of coal was close to a million tons *(9)*. Mining brought to the area many new European immigrants who were familiar with room-and-pillar mining techniques, which were necessary to support the unconsolidated bedrock. The coal seams are interbedded with shale, limestone, and sandstone. Under the coalbeds are huge supplies of fire clay and potter's clay *(9)*. The Vanmeter soils formed in the residuum above the bedrock, and the Lenzburg soils formed in the excavated overburden.

In the early 1900's, Macon County became involved in a large-scale drainage project. Thousands of acres of poorly drained and ponded Darwin and Chequest soils on the flood plain along the Chariton River were drained by a large channel. Swampland was converted to cropland *(7)*. Recent aerial photographs of the Chariton River show that the new, straightened channel has widened considerably in recent years and is now developing the meanders of a natural stream.

Both of the major highways in Macon County follow historic trails. State Highway 63 follows the historic Bee trace from north to south along the Grand Divide. State Highway 36 was constructed near the Hannibal and St. Joseph stage road. This stage road provided the 1849 gold seekers their most direct route west *(24)*.

## Farming

Macon County is a rural county, and farming is the main enterprise. The main crops are corn, soybeans, winter wheat, legumes, and grasses. Raising beef cattle and hogs is the main livestock enterprise.

In 1987, Macon County had 1,172 farms, which averaged about 336 acres in size. Of the total acreage used for farming, about 67 percent was used as cropland *(22)*.

At the time of the first settlement in 1827, much of the county was covered with hardwood forests. These wooded areas have been steadily cleared and converted to agricultural uses. Currently, only about 16 percent of the acreage is wooded *(10)*.

Before the Civil War, hemp and tobacco were the major crops. Cattle were raised in limited numbers to supplement income and to supply food to individual families. After the Civil War, the production of grain, especially corn, increased.

The total acreage and yields of crops have fluctuated significantly during the past 100 years. In 1879, about 87,471 acres of corn was harvested. It yielded 37 bushels per acre. In 1987, about 26,000 acres yielded about 105 bushels of corn per acre, and in 1988, which was a year of severe drought, 19,000 acres yielded about 53 bushels per acre *(12)*.

Soybeans were introduced in the county in the early 1940's. They gained popularity as a cover and forage crop and currently make up the largest acreage of any crop in the county. The acreage of harvested soybeans increased from 18,300 acres in 1950, with an average yield of 22 bushels per acre, to 102,500 acres in 1980, with an average yield of 26 bushels per acre. In 1987, the harvested acreage was 84,880 acres, with an average yield of about 34 bushels per acre. In 1988, the harvested acreage was 68,400 acres, with an average yield of about 22 bushels per acre *(12)*.

Livestock numbers have varied greatly since the turn of the century. Both cattle and hog numbers were at a low in 1850, when the county had about 7,432 cattle and 31,773 hogs. In 1988, the county had about 34,500 hogs and 50,400 cattle *(11)*. The highest numbers recorded are 65,530 hogs in 1880 and 76,800 cattle in 1975 *(12)*.

## Physiography, Relief, and Drainage

Michael L. Chalfant, soil scientist, Missouri Department of Natural Resources, helped prepare this section.

The landscape of Macon County is mainly characterized by gently sloping to strongly sloping uplands. The county is on the Dissected Till Plains, which date from the Pre-Illinoian stage of the

Pleistocene Epoch. The surface was created by glaciation. At least two glacial advances crossed the survey area, and they transported glacial material that buried previous landforms. When the glacial ice retreated, it left a wide plain that gradually sloped towards the south. This original plain surface was modified by geological erosion and by deposition. In some areas drainage patterns extend through the glacial till overburden to the underlying bedrock formations of Pennsylvanian and Mississippian age. More nearly level areas that have not been dissected have accumulated thick layers of loess. The present topography is a product of these earlier processes, and the only remnants of the once extensive plain currently exist on the summits of drainage divides *(5)*.

Macon County consists of two recognized topographic divisions. The western two-thirds of the county is in the Moderately Dissected Plains, and the eastern one-third is in the Smooth Plains. The western edge of the Grand Divide separates the two divisions. The Grand Divide is a broad, nearly level to gently sloping landform that is covered with loess and extends in a north-south direction through the county. This remnant plain is the drainage divide for the upper reaches of the Missouri River and Mississippi River systems.

Within the Smooth Plains division, the landscape gradually slopes towards the southeast. This area is drained by the Salt River and Bear Creek and their tributaries. Putnam, Mexico, and Adco soils are on the more stable, nearly level and very gently sloping upland summits. They formed in loess or in loess and the underlying pedisediments. In concave areas below the broad summits, Leonard soils formed in a thin layer of loess and in the underlying pedisediments or paleosol. Leonard soils slope towards drainageways that lead into tributaries of the Salt River. Keswick and Winnegan soils on the lower side slopes have eroded to the paleosol or into the underlying glacial till.

The Moderately Dissected Plains division is west of the Grand Divide. The physiography exhibits transitional characteristics, with the central part of the county typified by a rolling topography and somewhat narrow ridges. Adco and Bevier soils are on summits. Adco soils formed in loess, and Bevier soils formed in loess and pedisediments. Armstrong soils formed in pedisediments and the underlying paleosol. They are on back slopes. The central part of the county was the most intensively mined area and has about 7,000 acres of unreclaimed mine spoils that are mapped as Lenzburg soils. The area is drained by the East and Middle Fork of the Little Chariton River. Tributaries include Long Branch Creek, Sweezer Creek, Claybank Creek, and Stinking Creek.

The western part of the county has the most dissected topography. The predominant landforms are narrow ridges with moderately steep to very steep side slopes. The primary divides have a thin cap of loess overlying pedisediments and glacial till. Bevier soils formed on the narrow ridges. Purdin soils formed in glacial till below the Bevier soils. This part of the survey area is drained by the Chariton River and its tributaries, which include Walnut Creek, Turkey Creek, White Oak Creek, Painter Creek, Puzzle Creek, Mussel Fork, and Brush Creek. All of the major streams in the Moderately Dissected Plains division flow south through the county.

The major flood plains in the county are along the Chariton and Salt Rivers. The Chariton River flood plain is as much as 3 miles wide in some places. The poorly drained Darwin and Chequest soils are the major soils on the flood plain. Dockery and Floris soils formed in silty and loamy alluvial deposits adjacent to the natural stream channel. Chariton and Gifford soils are on the high stream terraces adjacent to the flood plain. The Chariton River has numerous tributaries, which drain the western areas of the highly dissected uplands. These smaller streams have deposited loamy and silty sediments along the narrow flood plains. Floris, Tice, Blackoar, and Piopolis soils formed in these sediments. Bremer soils are on low stream terraces along these tributaries. In some places limestone, sandstone, and shale bedrock has been exposed by the downcutting of streams.

The Salt River drains the eastern part of the county. It has fewer tributaries and a steeper slope than the Chariton River. The dominant soils are the frequently flooded Piopolis and Wilbur soils. Moniteau and Vesser soils are on the slightly higher flood plains along these tributaries. The lower limits of streams have carved deeply into preglacial deposits. In some places sandstone, shale, and limestone bedrock has been exposed.

## How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of additional soil data, modifications in series concepts, variations in the intensity of mapping or in the extent of the soils in the survey areas, or correlation decisions that reflect local conditions.

## Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

# General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

## Soil Descriptions

### 1. Adco-Leonard Association

*Very gently sloping and gently sloping, somewhat poorly drained and poorly drained, silty soils; on uplands*

This association consists of soils on broad upland ridges that have long side slopes and small, branching drainageways. These ridges generally are uniform in elevation. They are in the upper reaches of watershed basins. Slopes range from 1 to 6 percent.

This association makes up about 13 percent of the county. It is about 53 percent Adco and similar soils, 37 percent Leonard soils, and 10 percent minor soils (fig. 2).

Adco soils are somewhat poorly drained. They are very gently sloping and are on ridgetops in landscape positions higher than those of the Leonard soils. Typically, the surface layer is very dark gray silt loam. The subsurface layer is grayish brown, mottled silty clay loam. The upper part of the subsoil is dark gray, mottled clay. The lower part is grayish brown, mottled silty clay. The substratum is dark gray, mottled silty clay loam.

Leonard soils are poorly drained. They are gently sloping and are on concave head slopes of narrow drainageways. Typically, the surface layer is very dark grayish brown silty clay loam. The upper part of the subsoil is dark grayish brown and grayish brown, mottled silty clay. The lower part is grayish brown and light brownish gray, mottled silty clay loam and silty clay.

Minor in this association are the moderately well drained Armstrong and Keswick soils, which are on convex side slopes below the Leonard soils, and the poorly drained Putnam soils, which are on the higher, broader, nearly level ridgetops.

Most areas of this association are used for cultivated crops or small acreages of pasture and hay. Other areas are used for urban development. The major soils are suited to corn, soybeans, grain sorghum, winter wheat, and water-tolerant grasses and legumes. The hazard of erosion and surface wetness during spring and winter are the main management concerns in cultivated areas. Overgrazing and grazing when the soils are wet are the main concerns in managing pasture.

The major soils in this association are suited to building site development, local roads and streets, and some kinds of onsite waste disposal. The shrink-swell potential, the potential for frost action, wetness, and low strength are the major limitations.

### 2. Armstrong-Keswick-Leonard Association

*Gently sloping and moderately sloping, moderately well drained to poorly drained, loamy and silty soils; on uplands*

This association consists of soils on narrow, meandering, convex ridgetops, on head slopes of narrow drainageways, and on dissected side slopes. Slopes range from 2 to 9 percent.

This association makes up about 12 percent of the county. It is about 47 percent Armstrong soils, 31 percent Keswick soils, 13 percent Leonard soils, and 9 percent minor soils (fig. 3).

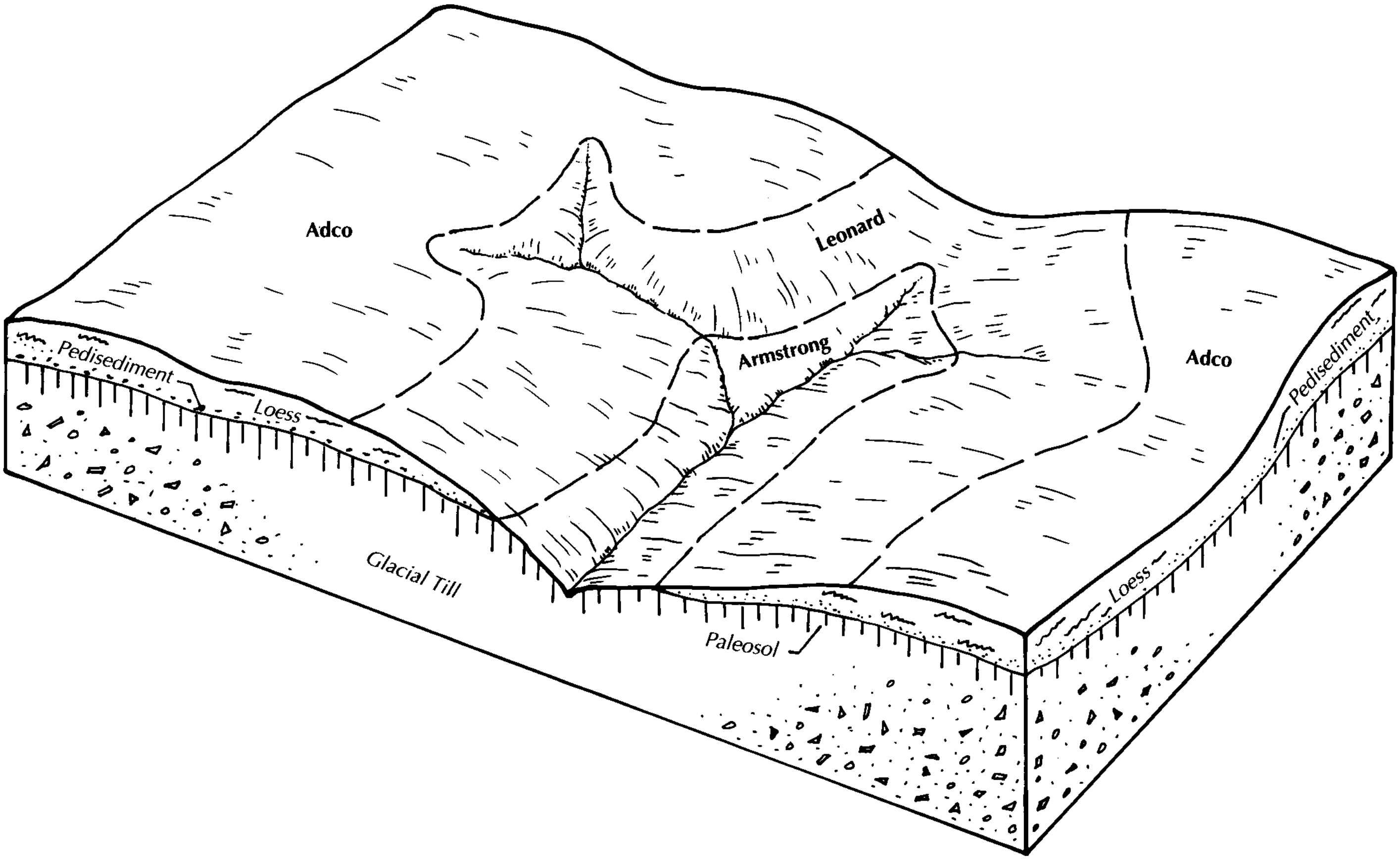


**Figure 2.—Typical pattern of soils and parent material in the Adco-Leonard association.**

Armstrong soils are somewhat poorly drained. They are gently sloping and moderately sloping and are on convex side slopes and ridgetops. Typically, the surface layer is very dark grayish brown loam. The upper part of the subsoil is yellowish brown loam. The lower part is light yellowish brown, yellowish brown, pale brown, brown, strong brown, and dark yellowish brown, mottled clay loam.

Keswick soils are moderately well drained. They are moderately sloping and are on convex side slopes and ridgetops. Typically, the surface layer is very dark grayish brown and dark brown clay loam. The subsoil is yellowish brown, strong brown, and dark yellowish brown, mottled clay and clay loam.

Leonard soils are poorly drained. They are gently sloping and are on concave side slopes and head slopes in landscape positions higher than those of the Armstrong and Keswick soils. Typically, the surface layer is very dark grayish brown silty clay loam. The upper part of the subsoil is dark grayish brown and grayish brown, mottled silty clay. The lower part is grayish brown and light brownish gray, mottled silty clay loam and silty clay.

Minor in this association are the nearly level, frequently flooded Wilbur soils on narrow flood plains and the very gently sloping Adco soils on the wider ridgetops.

The soils in this association are used mainly for pasture and hay or as cropland. Because of the slope and the hazard of erosion, conservation practices are needed if the major soils are used for cultivated crops. Wetness also is a limitation on the Leonard soils. The major soils are suited to pasture and hay. The hazard of erosion, overgrazing, and grazing when the soils are wet are the main management concerns.

The major soils in this association are suited to building site development but are unsuited to conventional septic tank absorption fields. The slope, wetness, the shrink-swell potential, and the potential for frost action are limitations that are difficult to overcome with commonly used construction techniques.

### 3. Winnegan-Keswick-Armstrong Association

*Strongly sloping and moderately steep, somewhat poorly drained and moderately well drained, loamy soils; on uplands*

This association consists of soils on narrow upland ridgetops and highly dissected side slopes adjacent to minor drainageways. Slopes range from 9 to 20 percent.

This association makes up about 45 percent of the county. It is about 27 percent Winnegan and similar soils, 25 percent Keswick soils, 24 percent Armstrong soils, and 24 percent minor soils.

Winnegan soils are moderately steep and are lower on the landscape than the Armstrong and Keswick soils. Typically, the surface layer is dark grayish brown loam. The subsoil is brown, strong brown, and yellowish brown clay loam and clay. It is mottled in the lower part.

Keswick soils are strongly sloping and moderately steep. Typically, the surface layer is brown clay loam. The subsoil is brown, strong brown, light yellowish brown, and yellowish brown, mottled clay and clay loam. The substratum is yellowish brown, mottled clay loam.

Armstrong soils are strongly sloping. Typically, the surface layer is very dark gray loam. The upper part of the subsoil is brown and yellowish brown, mottled clay. The lower part is brown and yellowish brown, mottled clay loam. The substratum also is brown and yellowish brown, mottled clay loam.

Minor in this association are Tice, Moniteau, Wilbur, and Zook soils. Tice and Wilbur soils are silty. They are on flood plains along streams and drainageways. Tice soils are somewhat poorly drained, and Wilbur soils are moderately well drained. The nearly level, poorly drained, silty Moniteau soils are on the slightly higher flood plains at the base of the sloping uplands. The gently sloping, poorly drained Zook soils are at the base of the sloping uplands.

Most areas of this association are used for pasture and hay. Some areas have been used as cropland, and a few areas are wooded. The native vegetation consists of prairie grasses in the less sloping areas and hardwoods in the steeper, more dissected areas.

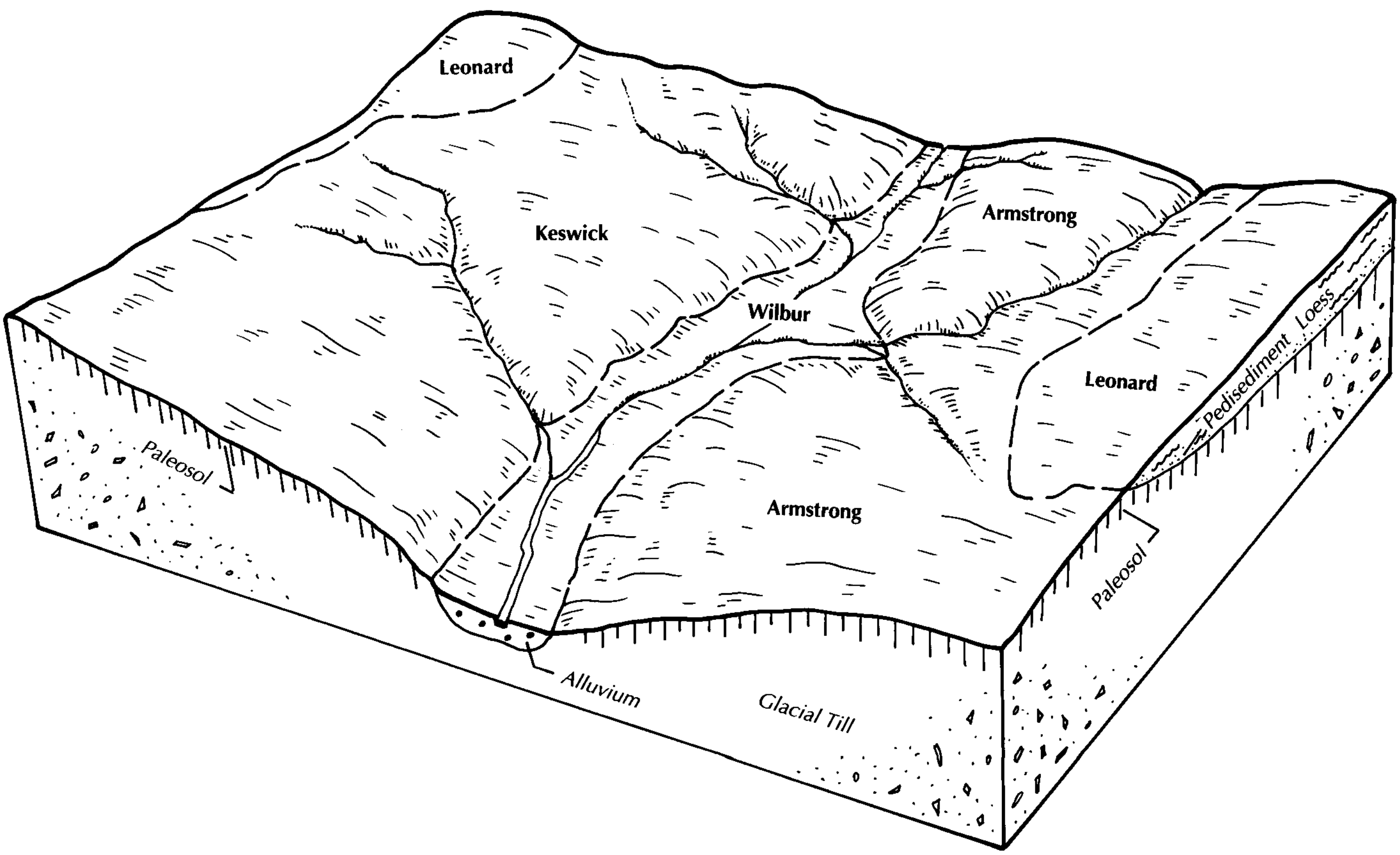


**Figure 3.—Typical pattern of soils and parent material in the Armstrong-Keswick-Leonard association.**

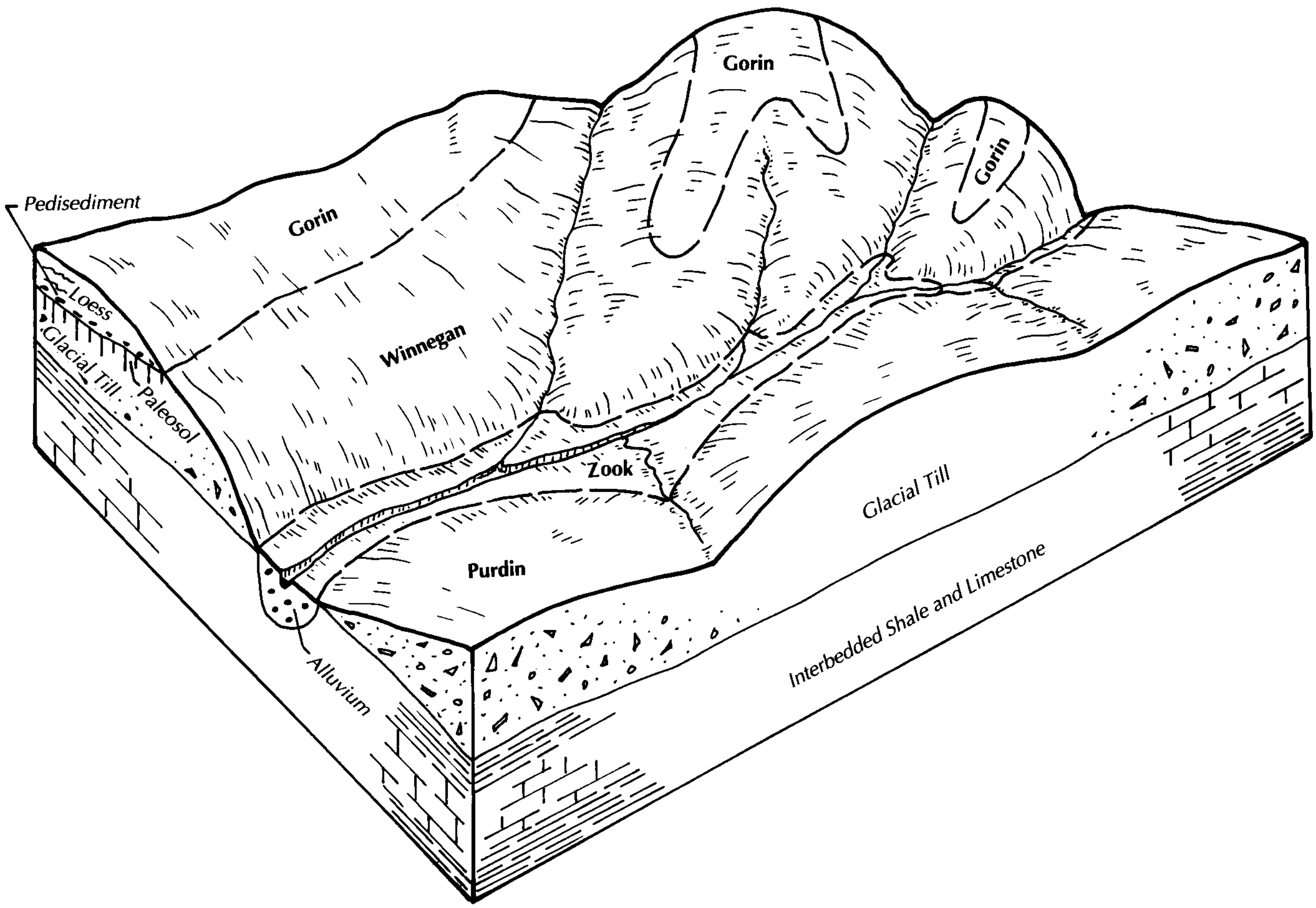


**Figure 4.—Typical pattern of soils and parent material in the Winnegan-Gorin-Purdin association.**

These soils generally are unsuited to cultivated crops because of the slope and a severe hazard of erosion. The major soils are suited to pasture and hay. The hazard of erosion, overgrazing, and grazing when the soils are wet are the main management concerns.

The major soils in this association are suited to building site development but are unsuited to conventional septic tank absorption fields. The slope, wetness, the shrink-swell potential, and the potential for frost action are limitations.

### 4. Winnegan-Gorin-Purdin Association

*Gently sloping to steep, somewhat poorly drained and moderately well drained, loamy and silty soils; on uplands*

This association consists of soils on long, narrow, convex ridgetops and very steep side slopes adjacent to flood plains along the major streams. Slopes range from 3 to 35 percent.

This association makes up about 16 percent of the county. It is about 44 percent Winnegan and similar soils, 20 percent Gorin and similar soils, 18 percent Purdin soils, and 18 percent minor soils (fig. 4).

Winnegan soils are moderately well drained. They are on steep side slopes in lower positions on the landscape than those of the Gorin soils. Typically, the surface layer is very dark grayish brown loam. The subsurface layer is yellowish brown loam. The upper part of the subsoil is yellowish brown clay. The next part is yellowish brown, mottled clay and clay loam. The lower part is yellowish brown, dark yellowish brown, strong brown, and light brownish gray clay loam. The substratum is dark yellowish brown and light brownish gray, mottled clay loam.

Gorin soils are somewhat poorly drained. They are gently sloping and moderately sloping and are on narrow, convex ridgetops. Typically, the surface layer is dark grayish brown silt loam. The subsoil is dark brown, brown, strong brown, and yellowish brown silty clay loam, clay loam, and silty clay.

Purdin soils are moderately well drained. They are moderately steep and steep and are on smoother, less dissected side slopes and ridgetops than the Gorin and Winnegan soils. Typically, the surface layer is very dark gray clay loam. The subsoil is yellowish brown, dark grayish brown, and olive gray clay and clay loam. It is mottled in the lower part. The substratum is dark yellowish brown, yellowish brown, and olive gray clay loam.

Minor in this association are Zook, Tice, and Vanmeter soils. The poorly drained Zook soils and the moderately well drained Tice soils are on narrow drainageways and on flood plains that are frequently flooded. The moderately deep, moderately well drained Vanmeter soils are on the lower side slopes and foot slopes.

Most areas of this association are used as woodland. Some areas are used for pasture and hay. The Winnegan and Purdin soils are unsuited to cultivated crops because of the slope, which results in a severe hazard of erosion.

Most of the steeper areas of these soils are poorly suited to pasture. The less sloping areas on ridgetops are the best suited. The hazard of erosion, the equipment limitation, and overgrazing are the main management concerns. Overgrazing causes compaction and reduces the density of the pasture plants.

The soils in this association are suited to woodland, and large areas are wooded. The native vegetation consists of hardwoods. The equipment limitation and seedling mortality are the main management concerns.

The soils in this association generally are not used for building site development or waste disposal systems because of the slope, the hazard of erosion, and wetness.

### 5. Darwin-Dockery-Chequest Association

*Nearly level, poorly drained and somewhat poorly drained, clayey and silty soils; on flood plains*

This association consists of soils on broad or very broad flood plains. Slopes range from 0 to 2 percent.

This association makes up about 7 percent of the county. It is about 28 percent Darwin soils, 23 percent Dockery and similar soils, 20 percent Chequest soils, and 29 percent minor soils.

Darwin soils are poorly drained. They are in very broad slack-water areas on flood plains and generally are farther from the original stream channel than the Dockery and Chequest soils. Typically, the surface layer is very dark gray silty clay. The subsoil is dark gray and gray, mottled silty clay loam.

Dockery soils are somewhat poorly drained. They are near the original stream channel. Typically, the surface layer is dark brown and dark grayish brown silt loam. The substratum is brown, mottled silt loam and loam.

Chequest soils are poorly drained. They commonly are between the Darwin and Dockery soils on the landscape. Typically, the surface layer is very dark gray silty clay loam. The subsoil is very dark gray and dark gray, mottled silty clay loam. The substratum is gray, mottled silty clay loam.

Minor in this association are Bremer, Floris, and Gifford soils. The poorly drained Bremer and Gifford soils are on stream terraces in the slightly higher landscape positions adjacent to the flood plains and at the base of the more sloping uplands. The moderately well drained Floris soils are on flood plains adjacent to the original stream channel.

Most areas of this association are used as cropland. Some areas are used for pasture and hay or as woodland. The poorly drained Darwin and Chequest soils are often tilled in the fall. The better drained Dockery soils can be worked and planted earlier in the spring than the Darwin and Chequest soils. Flooding from local tributaries or from breaks in levees is the main hazard.

Most areas of this association are suited to pasture and hay, but very few areas are used for these purposes. Overgrazing and grazing when the soils are wet are the main management concerns.

The soils in this association are suited to woodland. Some areas support native hardwoods. Seedling mortality and the equipment limitation caused by wetness are the main management concerns.

The soils in this association are unsuited to building site development and most waste disposal systems because of the shrink-swell potential, the potential for frost action, the wetness, and the hazard of flooding.

### 6. Piopolis-Wilbur-Moniteau Association

*Nearly level and very gently sloping, poorly drained and moderately well drained, silty soils; on flood plains*

This association consists of soils on narrow or broad, intermediate-sized flood plains. Slopes range from 0 to 3 percent.

This association makes up about 6 percent of the county. It is about 37 percent Piopolis and similar soils, 28 percent Wilbur and similar soils, 28 percent Moniteau and similar soils, and 7 percent minor soils (fig. 5).

Piopolis soils are poorly drained. They are on broad flood plains and generally are farther from the stream channel than the Wilbur and Moniteau soils. Typically,

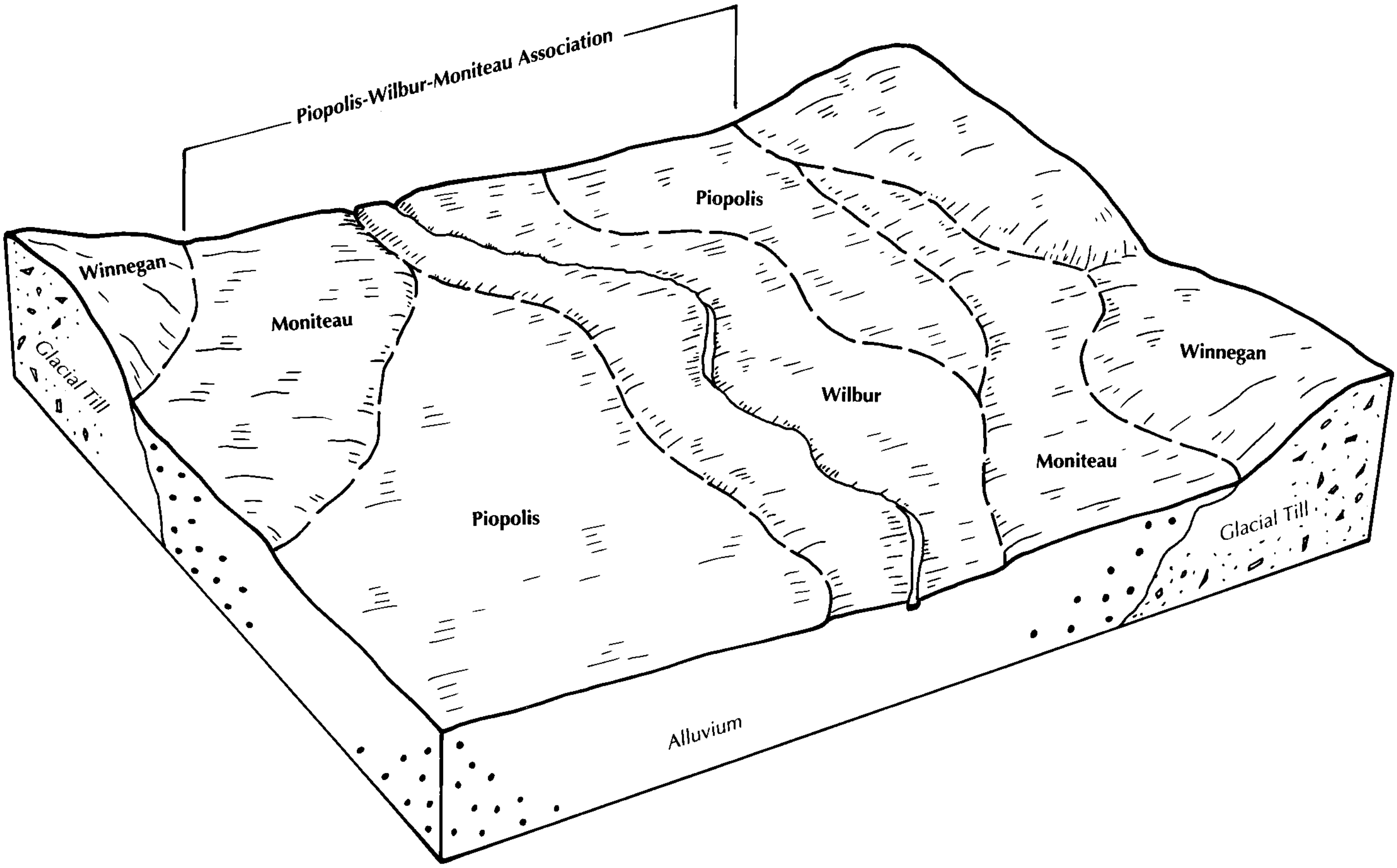


**Figure 5.—Typical pattern of soils and parent material in the Piopolis-Wilbur-Moniteau association. The Winnegan soils are in an adjoining association on uplands.**

the surface layer is dark grayish brown and dark gray, mottled silty clay loam. The substratum is grayish brown, gray, dark gray, and light brownish gray, mottled silty clay loam.

Wilbur soils are moderately well drained. They are on narrow flood plains near the original stream channel. Typically, the surface layer is brown silt loam. The substratum is brown, pale brown, and grayish brown, mottled silt loam.

Moniteau soils are poorly drained. They are in the higher areas on the flood plain. Typically, the surface layer is grayish brown and brown silt loam. The subsurface layer is mottled, light brownish gray silt loam. The subsoil is grayish brown, dark grayish brown, and dark gray, mottled silty clay loam.

Minor in this association are Floris soils and Aquents. The moderately well drained Floris soils are near the stream channel. The very poorly drained Aquents are adjacent to manmade lakes.

Most areas of this association are used as cropland or for hay and pasture. Some areas are wooded. The poorly drained Piopolis and Moniteau soils are often tilled in the fall. The better drained Wilbur soils can be worked and planted earlier in the spring than the Piopolis and Moniteau soils. Flooding and wetness are the main management concerns. Some areas have been channelized, and others are protected by flood-control structures.

Most areas of this association are suited to pasture and hay. Overgrazing and grazing when the soils are wet are the main management concerns.

The soils in this association are suited to woodland, and some areas are wooded. The native vegetation consists of hardwoods. Seedling mortality and the equipment limitation caused by wetness and flooding are the main management concerns.

The soils in this association are unsuited to building site development and waste disposal systems because of the potential for frost action, the wetness, and the hazard of flooding.

## 7. Lenzburg Association

*Very steep, well drained, loamy soils formed in mine spoils; on uplands*

This association consists of soils on narrow, linear piles of mine spoils in areas of abandoned strip mines. Slopes range from 35 to 70 percent.

This association makes up less than 1 percent of the county.

Lenzburg soils typically have a surface layer of grayish brown clay loam. The substratum is multicolored clay loam.

The soils in this association are planted to grass for pasture or are reverting to woodland and are used as wildlife habitat. The soils are not suited to cultivated crops, hay, or building site development because of the slope.

# Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Keswick clay loam, 9 to 20 percent slopes, severely eroded, is a phase of the Keswick series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. These areas are too small to be shown as separate delineations and are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

## Soil Descriptions

**14C2—Armstrong loam, 3 to 9 percent slopes, eroded.** This very deep, gently sloping and moderately sloping, somewhat poorly drained soil is on low ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 6 inches; very dark grayish brown, friable loam

*Subsoil:*
6 to 12 inches; yellowish brown, friable clay loam
12 to 16 inches; yellowish brown, pale brown, light brownish gray, and yellowish red, mottled, friable clay loam
16 to 60 inches; brown, yellowish brown, dark yellowish brown, and strong brown, mottled, firm clay loam

In some areas, the surface layer is silt loam or silty clay loam and the upper part of the subsoil has less sand and gravel. In other areas grayish brown mottles start at a lower depth.

Included with this soil in mapping are small areas of the poorly drained Leonard soils and small areas of severely eroded Armstrong soils. Leonard soils are at the head of drainageways above the Armstrong soil on side slopes. The severely eroded Armstrong soils are in the steepest areas. Included soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

*Permeability:* Slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 1 to 3 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Erosion has resulted in the loss of about one-half of the original topsoil. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion.

This soil is suited to trees, and a few areas support native hardwoods. Seedling mortality is a management concern. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3C, and the indicator species is white oak.

**14D2—Armstrong loam, 9 to 14 percent slopes, eroded.** This very deep, strongly sloping, somewhat poorly drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 6 inches; very dark gray, friable loam

*Subsoil:*
6 to 21 inches; dark yellowish brown and brown, mottled, firm clay
21 to 50 inches; yellowish brown and brown, mottled, firm clay loam

*Substratum:*
50 to 60 inches; brown and yellowish brown, mottled, firm clay loam

In some areas, the surface layer is silt loam or silty clay loam and the upper part of the subsoil has less sand and gravel. In other areas grayish brown mottles start at a lower depth.

Included with this soil in mapping are small areas of the poorly drained Zook soils and small areas of severely eroded Armstrong soils. Zook soils are in drainageways. The severely eroded Armstrong soils have a lighter colored surface layer than the major Armstrong soil. They are in convex areas. Included soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 1 to 3 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

This soil is used mostly for hay and pasture (fig. 6) and for cultivated crops. Some areas are wooded. The

**Figure 6.—Hay and pasture in an area of Armstrong loam, 9 to 14 percent slopes, eroded.**

soil is suited to cultivated crops on a limited basis if proper erosion-control measures are used. Corn, soybeans, winter wheat, and grain sorghum are the most commonly grown crops. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Erosion has resulted in the loss of one-half of the original topsoil. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, timothy, switchgrass, alsike clover, crownvetch, tall fescue, big bluestem, and indiangrass. The species that can withstand wetness grow well. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion.

This soil is suited to trees, and some areas support native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting reduce the windthrow hazard.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the slope, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is IVe. The woodland ordination symbol is 3C, and the indicator species is white oak.

**15C3—Armstrong clay loam, 5 to 9 percent slopes, severely eroded.** This very deep, moderately sloping, somewhat poorly drained soil is on narrow ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 4 inches; very dark gray, friable clay loam

*Subsoil:*
4 to 22 inches; strong brown and brown, mottled, firm clay
22 to 36 inches; strong brown, mottled, firm clay loam
36 to 60 inches; gray and light brownish gray, mottled, firm clay loam

In some areas the upper part of the subsoil does not have grayish brown mottles.

Included with this soil in mapping are small areas of the poorly drained Leonard soils. These soils are on concave side slopes and head slopes above the Armstrong soil. They make up about 8 percent of the unit.

Important properties of the Armstrong soil—

*Permeability:* Slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 1 to 3 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to cultivated crops only on a limited basis because of the severe hazard of erosion. Erosion has resulted in the loss of three-fourths or more of the original topsoil. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion.

This soil is suited to trees, and a few areas support native hardwoods. Seedling mortality and the windthrow hazard are management concerns. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting reduce the windthrow hazard.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IVe. The woodland ordination symbol is 3C, and the indicator species is white oak.

**15D3—Armstrong clay loam, 9 to 14 percent slopes, severely eroded.** This very deep, strongly sloping, somewhat poorly drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*

0 to 5 inches; very dark gray, friable clay loam

*Subsoil:*

5 to 10 inches; yellowish brown and brown, firm clay

10 to 18 inches; brown, mottled, firm clay

18 to 38 inches; brown, yellowish brown, and dark yellowish brown, mottled, firm clay loam

*Substratum:*

38 to 60 inches; light olive brown and yellowish brown, mottled, firm clay loam

Included with this soil in mapping are small areas of the poorly drained Zook soils in drainageways. These soils make up about 3 percent of the unit.

Important properties of the Armstrong soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 1 to 3 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for hay and pasture or for cultivated crops. Some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Erosion has resulted in the loss of three-fourths or more of the original topsoil. Many cultivated areas of this soil are being reseeded to grass to protect them from further erosion.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, timothy, switchgrass, alsike clover, crownvetch, tall fescue, big bluestem, and indiangrass. The species that can withstand wetness grow well. Controlling erosion during seedbed preparation is the main management concern. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour farming help to control erosion. Timely tillage and a quickly established ground cover also help to control erosion.

This soil is suited to trees, and some areas support native hardwoods. Seedling mortality and the windthrow hazard are management concerns. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting reduce the windthrow hazard.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Land grading reduces the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the slope, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by shrinking and swelling, wetness, and frost action. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is VIe. The woodland ordination symbol is 3C, and the indicator species is white oak.

**16C2—Bevier silty clay loam, 3 to 8 percent slopes, eroded.** This very deep, gently sloping and moderately sloping, somewhat poorly drained soil is on narrow, convex ridgetops in the uplands. Individual areas are long and narrow and range from about 15 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 6 inches; very dark gray, friable silty clay loam

*Subsoil:*
6 to 22 inches; dark grayish brown, mottled, firm silty clay
22 to 34 inches; grayish brown and light brownish gray, mottled, firm silty clay loam
34 to 42 inches; grayish brown, yellowish brown, and brown, firm silt loam

*Substratum:*
42 to 60 inches; grayish brown and yellowish brown, firm loam

In some areas the surface layer and the upper part of the subsoil have more sand and gravel.

Included with this soil in mapping are small areas of the strongly sloping Armstrong and Purdin soils on the lower side slopes. Included soils make up about 5 percent of the unit.

Important properties of the Bevier soil—

*Permeability:* Slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 2 to 4 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for pasture and hay or for cultivated crops. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. Erosion has resulted in the loss of one-third to one-half of the original topsoil. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Most areas are smooth and are suited to contour farming. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover. It is moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is a management concern. Timely tillage and a quickly established ground cover help to control erosion.

This soil is suited to trees, and a few areas support native hardwoods. Seedling mortality is the main management concern. Planting container-grown nursery stock or reinforcement planting increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3C, and the indicator species is white oak.

**17C—Purdin loam, 5 to 9 percent slopes.** This very deep, moderately sloping, moderately well drained soil is on narrow, convex ridgetops in the uplands. Individual areas are long and narrow and range from about 25 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 8 inches; very dark gray, friable loam

*Subsurface layer:*
8 to 12 inches; brown, friable clay loam

*Subsoil:*
12 to 20 inches; dark yellowish brown, firm clay
20 to 47 inches; yellowish brown and dark yellowish brown, mottled, firm clay
47 to 60 inches; yellowish brown, mottled, firm clay loam

In some areas the surface layer and the upper part of the subsoil have less sand and gravel.

Included with this soil in mapping are areas of the moderately steep Purdin soils. These soils are at the edges of the unit. They make up about 8 to 15 percent of the unit.

Important properties of the Purdin soil—

*Permeability:* Slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for pasture and hay. A few areas are used for cultivated crops or woodland. This soil is suited to cultivated crops. If the soil is used for cultivated crops, the hazard of erosion is severe. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redtop, timothy, switchgrass, alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. Timely preparation of the seedbed and establishing the seedbed on the contour promote the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is well suited to trees. There are no major management concerns.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A, and the indicator species is white oak.

**17E—Purdin loam, 14 to 20 percent slopes.** This very deep, moderately steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 7 inches; very dark gray, very friable loam

*Subsurface layer:*
7 to 11 inches; yellowish brown, friable clay loam

*Subsoil:*
11 to 35 inches; yellowish brown and light yellowish brown, firm clay loam
35 to 46 inches; grayish brown and light olive brown, firm clay loam

*Substratum:*
46 to 60 inches; light olive brown and light brownish gray, firm clay loam

Included with this soil in mapping are small areas of the poorly drained Zook soils on narrow flood plains. These soils make up about 4 percent of the unit.

Important properties of the Purdin soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for hay and pasture. A few areas are used for cultivated crops or woodland. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. It is well suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redtop, timothy, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour farming help to control erosion. Timely preparation of the seedbed promotes the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and a few areas support native hardwoods. The main management concerns are the equipment limitation and the hazard of erosion. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Thinning and selective cutting of undesirable trees are needed in most existing stands.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**17E2—Purdin loam, 14 to 20 percent slopes, eroded.** This very deep, moderately steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 5 inches; very dark gray, friable loam

*Subsoil:*
5 to 10 inches; brown, firm clay loam
10 to 40 inches; yellowish brown, mottled, firm clay and clay loam

*Substratum:*
40 to 60 inches; yellowish brown, mottled, firm clay loam

Included with this soil in mapping are small areas of the poorly drained Zook soils and areas of Purdin soils that are severely eroded. Zook soils are on narrow flood plains. The severely eroded Purdin soils are in convex areas. Included soils make up about 8 percent of the unit.

Important properties of the Purdin soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas have been cultivated in the past but are now used for hay and pasture. Some areas are wooded, and a few areas are used for cultivated crops. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Erosion has resulted in the loss of one-half or more of the original topsoil. This soil is well suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redtop, timothy, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion, especially during seedbed preparation, and overgrazing are the main management concerns. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour farming help to control erosion. Timely preparation of the seedbed promotes the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is suited to trees, and some areas support native hardwoods. The main management concerns are the equipment limitation and the hazard of erosion. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action. Designing roads so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**17F—Purdin loam, 20 to 35 percent slopes.** This very deep, steep, moderately well drained soil is on dissected, uneven side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 9 inches; very dark gray, friable loam

*Subsurface layer:*
9 to 13 inches; dark brown and very dark gray, friable clay loam

*Subsoil:*
13 to 25 inches; dark yellowish brown and brown, mottled, very firm clay
25 to 38 inches; dark yellowish brown and brown, mottled, firm clay loam

*Substratum:*
38 to 60 inches; brown and grayish brown, firm clay loam

In some areas the surface layer and the upper part of the subsoil have less sand and gravel.

Included with this soil in mapping are small areas of the poorly drained Zook soils on narrow flood plains. These soils make up about 3 percent of the unit.

Important properties of the Purdin soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas of this soil are used for pasture. A few areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion.

This soil is suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redtop, timothy, and switchgrass. It is moderately suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and grassed waterways minimize erosion. Timely preparation of the seedbed promotes the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. A few areas support stands of native hardwoods. The main management concerns are the equipment limitation and the hazard of erosion. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**17F2—Purdin clay loam, 20 to 35 percent slopes, eroded.** This very deep, steep, moderately well drained soil is on highly dissected, uneven side slopes. Individual areas are irregular in shape and range from about 25 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*

0 to 5 inches; very dark gray, friable clay loam

*Subsoil:*

5 to 9 inches; yellowish brown and dark grayish brown, firm clay

9 to 18 inches; yellowish brown, firm clay

18 to 44 inches; yellowish brown and olive gray, mottled, firm clay loam

*Substratum:*

44 to 60 inches; dark yellowish brown, yellowish brown, and olive gray, mottled, firm clay loam

Included with this soil in mapping are small areas of the poorly drained Zook soils on narrow flood plains. These soils make up about 3 percent of the unit.

Important properties of the Purdin soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for pasture. Some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Erosion has resulted in the loss of one-half or more of the original topsoil.

This soil is well suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redtop, timothy, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and grassed waterways minimize erosion. Timely preparation of the seedbed promotes the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. The main management concerns are the equipment limitation and the hazard of erosion. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**18C2—Gorin silt loam, 3 to 9 percent slopes, eroded.** This very deep, gently sloping and moderately sloping soil is somewhat poorly drained. It is on convex ridgetops and foot slopes in the uplands. Individual areas are long and narrow and range from about 15 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*

0 to 5 inches; dark grayish brown, friable silt loam

*Subsurface layer:*

5 to 8 inches; dark brown, friable silty clay loam

*Subsoil:*

8 to 16 inches; brown, firm silty clay

16 to 24 inches; yellowish brown, mottled, very firm silty clay

24 to 33 inches; yellowish brown, mottled, firm silty clay loam

33 to 45 inches; yellowish brown and brown, mottled, firm clay loam

45 to 60 inches; strong brown, mottled, firm clay

In some areas sand and gravel are in the surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of strongly sloping soils at the edges and in the lower parts of the unit. These areas make up about 5 to 8 percent of the unit.

Important properties of the Gorin soil—

*Permeability:* Very slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Low
*Seasonal high water table:* Perched at a depth of 2 to 4 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for pasture and hay or as woodland. Some larger areas, particularly on the broader foot slopes, are used for cultivated crops. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Erosion has resulted in the loss of about one-half of the original topsoil. Practices that minimize erosion on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and a crop rotation that includes hay or pasture crops. Insufficient soil moisture is often a limitation affecting row crops during the summer. High plant populations of corn and grain sorghum should be avoided. In its natural state, this soil is quite acid and is low in fertility. Additions of lime and fertilizer are needed. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, crownvetch, tall fescue, timothy, big bluestem, and indiangrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is a management concern. Timely tillage and a quickly established ground cover help to control erosion.

This soil is well suited to trees. Many areas support native hardwoods, dominantly good-quality white oak. Seedling mortality is the main management concern. Planting container-grown nursery stock or reinforcement planting during early spring increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3C, and the indicator species is white oak.

**19E2—Gosport loam, 14 to 20 percent slopes, eroded.** This moderately deep, moderately steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 6 inches; very dark grayish brown, very friable loam

*Subsoil:*
6 to 12 inches; yellowish brown, mottled, friable loam
12 to 20 inches; light yellowish brown, mottled, firm silty clay loam
20 to 22 inches; brown, mottled, very firm silty clay loam

*Bedrock:*
22 to 60 inches; soft shale and sandstone

In some areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the frequently flooded Wilbur and Floris soils. These soils are at the lower elevations on narrow, nearly level flood plains along small streams. Sandstone, limestone, and shale bedrock outcrops are on the steeper slopes adjacent to drainageways. Included areas make up about 2 to 5 percent of the unit.

Important properties of the Gosport soil—

*Permeability:* Very slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Depth to a seasonal high water table:* More than 6 feet
*Depth to bedrock:* 20 to 40 inches
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for pasture and hay. Some areas are used as woodland. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Erosion has resulted in the loss of about one-half of the original topsoil.

This soil is moderately well suited to birdsfoot trefoil, lespedeza, red fescue, orchardgrass, big bluestem, and indiangrass. Shallow-rooted species that tolerate droughtiness should be selected. Erosion is a serious hazard during seedbed preparation. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour farming minimize erosion. Timely tillage and a quickly established ground cover also help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and some areas support native hardwoods. The main management concerns are the hazard of erosion, the equipment limitation, seedling mortality, and the windthrow hazard. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Hand planting or reinforcement planting may be necessary. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope, the depth to bedrock, and the shrink-swell potential.

The depth to bedrock, low strength, the shrink-swell potential, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Establishing roads on the contour or on an adjacent soil in some places is necessary because of the depth to bedrock. In some places blasting is necessary to remove rock. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by frost action.

The land capability classification is VIe. The woodland ordination symbol is 2R, and the indicator species is white oak.

**22F—Vanmeter loam, 20 to 40 percent slopes.** This moderately deep, steep and very steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 4 inches; very dark gray, very friable loam

*Subsoil:*
4 to 7 inches; brown and very dark grayish brown, friable loam
7 to 13 inches; light olive brown, firm clay
13 to 30 inches; light olive brown and gray, mottled, firm clay and silty clay

*Bedrock:*
30 to 60 inches; soft, rippable shale

In some areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the frequently flooded Floris and Wilbur soils. These soils are on narrow, nearly level flood plains along small streams. Limestone and shale bedrock outcrops are on some of the steeper slopes adjacent to drainageways. Included areas make up about 3 to 5 percent of the unit.

Important properties of the Vanmeter soil—

*Permeability:* Very slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Depth to a seasonal high water table:* More than 6 feet
*Depth to bedrock:* 20 to 40 inches
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used as woodland. Some areas are used for pasture. This soil is unsuited to cultivated crops because of the slope and the severe hazard of erosion. It is moderately well suited to birdsfoot trefoil, lespedeza, red fescue, orchardgrass, big bluestem, and indiangrass. Shallow-rooted species that tolerate droughtiness should be selected. Erosion is a serious hazard during seedbed preparation. If the soil is tilled for the reseeding of pasture crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and grassed waterways minimize erosion. Timely tillage and a quickly established ground cover also help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and most areas support native hardwoods. The main management concerns are the hazard of erosion, the equipment limitation, seedling mortality, and the windthrow hazard. Haul roads and skid trails should be established across the slope. In the steepest areas the logs should be yarded uphill to logging roads or skid trails. Installing culverts and water breaks helps to control erosion. Hand planting or reinforcement planting may be necessary. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope, the depth to bedrock, and the shrink-swell potential.

The depth to bedrock, low strength, the shrink-swell potential, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets.

The land capability classification is VIIe. The woodland ordination symbol is 2R, and the indicator species is white oak.

**23C2—Keswick clay loam, 5 to 9 percent slopes, eroded.** This very deep, moderately sloping, moderately well drained soil is on ridgetops and side slopes in the uplands. Individual areas are long and narrow or irregular in shape and range from about 25 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
- 0 to 6 inches; very dark grayish brown and dark brown, friable clay loam

*Subsoil:*
- 6 to 21 inches; yellowish brown and strong brown, mottled, firm clay
- 21 to 50 inches; strong brown and yellowish brown, mottled, very firm and firm clay loam
- 50 to 60 inches; dark yellowish brown and yellowish brown, mottled, firm clay loam

In some areas the surface layer and the upper part of the subsoil have less sand and gravel.

Included with this soil in mapping are small areas of the poorly drained Leonard soils and areas of moderately steep soils. Leonard soils are in the higher landscape positions on concave head slopes. The moderately steep soils generally are near the lower areas of the unit. Included soils make up about 5 to 10 percent of the unit.

Important properties of the Keswick soil—

*Permeability:* Slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Low
*Seasonal high water table:* Perched at a depth of 1 to 3 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. Erosion has resulted in the loss of one-half or more of the original topsoil. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover. It is moderately well suited to alsike clover, crownvetch, tall fescue, big bluestem, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and a few areas support native hardwoods. The main management concerns are seedling mortality and the windthrow hazard. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting reduce the windthrow hazard.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3C, and the indicator species is white oak.

**23E3—Keswick clay loam, 9 to 20 percent slopes, severely eroded.** This very deep, strongly sloping and moderately steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
- 0 to 5 inches; brown, friable clay loam

*Subsoil:*
- 5 to 20 inches; brown, mottled, very firm clay
- 20 to 28 inches; strong brown and light yellowish brown, mottled, very firm clay
- 28 to 49 inches; yellowish brown, brown, and strong brown, mottled, firm clay loam

*Substratum:*
- 49 to 60 inches; yellowish brown, mottled, firm clay loam

Included with this soil in mapping are small areas of the frequently flooded Floris and Wilbur soils and areas of similar soils on steep slopes in the lower portions of the unit. Floris and Wilbur soils are on flood plains. Included areas make up about 5 percent of the unit.

Important properties of the Keswick soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Low
*Seasonal high water table:* Perched at a depth of 1 to 3 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

This soil is used for hay and pasture, woodland, or cultivated crops. It generally is unsuited to cultivated crops, however, because of the severe hazard of erosion. Erosion has resulted in the loss of three-fourths or more of the original topsoil. Many cultivated areas of this soil are being reseeded to grass to protect them from further erosion.

This soil is well suited to ladino clover. It is moderately well suited to alsike clover, crownvetch, tall fescue, big bluestem, and indiangrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is the main management concern. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour farming minimize erosion. Timely tillage and a quickly established ground cover also help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and some areas support native hardwoods. The main management concerns are the hazard of erosion, the equipment limitation, seedling mortality, and the windthrow hazard. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting reduce the windthrow hazard. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing

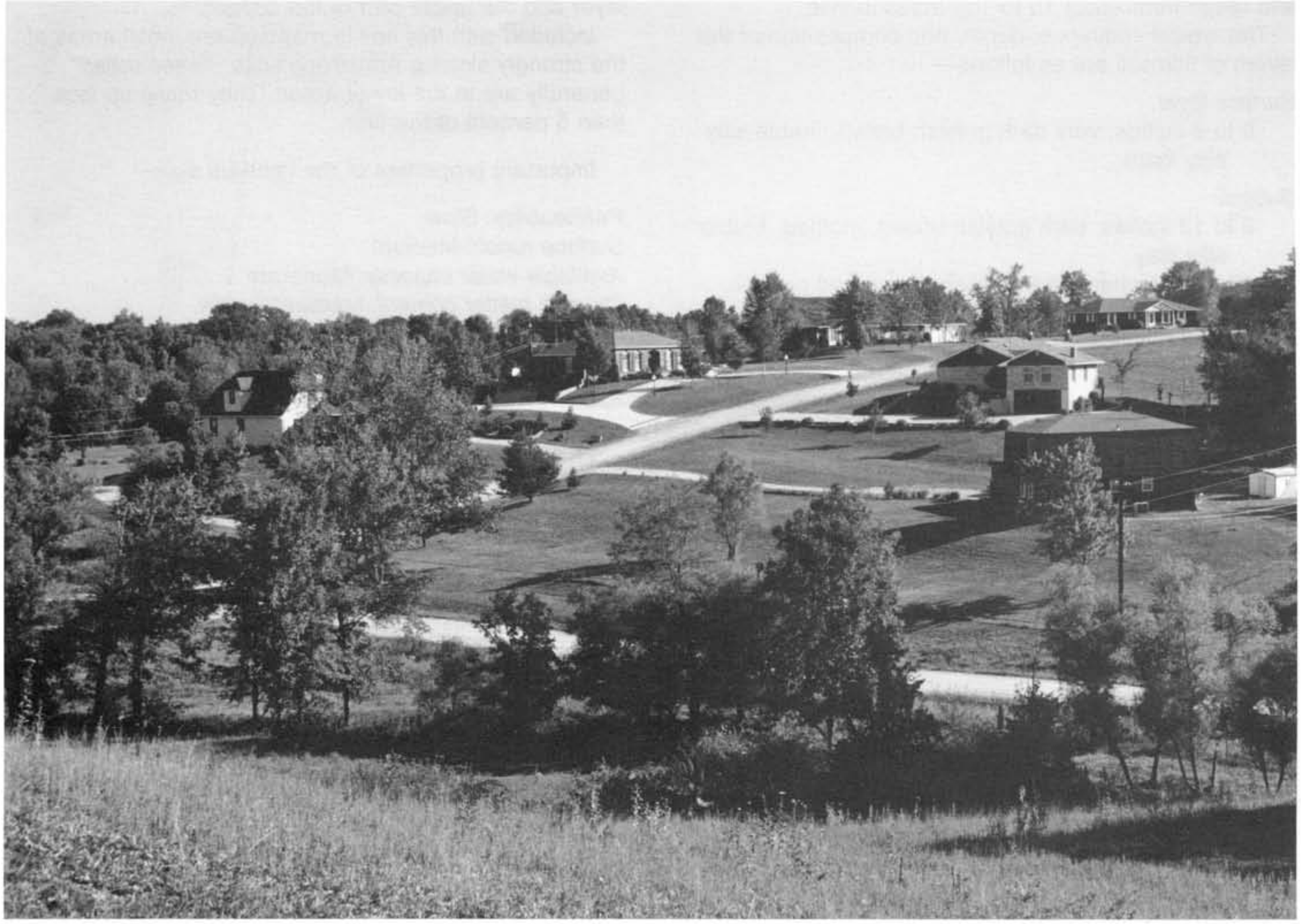

**Figure 7.—Building site development in an area of Keswick clay loam, 9 to 20 percent slopes, severely eroded.**

drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Land grading reduces the slope (fig. 7). Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness, the slow permeability, and the slope. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the potential for frost action, the wetness, and the slope limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**26B2—Leonard silty clay loam, 2 to 6 percent slopes, eroded.** This very deep, gently sloping, poorly drained soil is on concave side slopes and head slopes in the uplands. Individual areas are irregular in shape and range from about 15 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*

0 to 8 inches; very dark grayish brown, friable silty clay loam

*Subsoil:*

8 to 13 inches; dark grayish brown, mottled, friable silty clay

13 to 28 inches; dark grayish brown and grayish brown, mottled, firm silty clay

28 to 54 inches; grayish brown, mottled, firm silty clay loam

54 to 60 inches; light brownish gray, mottled, friable silty clay

In some areas the surface layer has less clay. In other areas sand and gravel are in the surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the strongly sloping Armstrong soils. These soils generally are in the lower areas. They make up less than 5 percent of the unit.

Important properties of the Leonard soil—

*Permeability:* Slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 0.5 foot to 2.0 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans,

**Figure 8.—Grassed waterways in an area of Leonard silty clay loam, 2 to 6 percent slopes, eroded. Grassed waterways help to prevent the formation of gullies.**

winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. Erosion has resulted in the loss of about one-half of the original topsoil. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways (fig. 8), contour farming, and stripcropping. Terraces are also practical if suitable outlets are available. Many areas have slopes that are long enough and smooth enough to be farmed on the contour and terraced. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is moderately well suited to hay and pasture. If the soil is used for pasture or hay, shallow-rooted species that can withstand wetness grow best. The soil is moderately well suited to switchgrass and moderately suited to alsike clover, birdsfoot trefoil, tall fescue, big bluestem, and indiangrass. Erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion. Restricted use during wet periods helps to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is suited to building site development. The shrink-swell potential and the wetness are the major limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

**27C—Winnegan loam, 5 to 9 percent slopes.** This very deep, moderately sloping, moderately well drained soil is on low, narrow ridgetops in the uplands. Individual areas are long and narrow and range from about 25 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 4 inches; very dark gray, friable loam

*Subsurface layer:*
4 to 8 inches; brown, friable loam

*Subsoil:*
8 to 26 inches; dark yellowish brown and yellowish brown, mottled, firm clay
26 to 33 inches; dark yellowish brown, mottled, firm clay loam

*Substratum:*
33 to 60 inches; grayish brown and light brownish gray, mottled, very firm clay loam

In some areas the surface layer and the upper part of the subsoil have less sand and gravel.

Included with this soil in mapping are small areas of Winnegan soils that are moderately steep. These soils are at the sides of the mapped areas. They make up about 8 percent of the unit.

Important properties of the Winnegan soil—

*Permeability:* Slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Low
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used as woodland. A few areas are used for hay and pasture. This soil is suited to cultivated crops. If the soil is used for cultivated crops, the hazard of erosion is severe. Practices that minimize erosion on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility and increase the available water capacity and the rate of water infiltration.

This soil is well suited to red clover, ladino clover, birdsfoot trefoil, tall fescue, crownvetch, red fescue, redtop, timothy, switchgrass, alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. Timely preparation of the seedbed and establishing the seedbed on the contour promote the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is well suited to trees. Most areas support native hardwoods. There are no major management concerns.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A, and the indicator species is white oak.

**27E2—Winnegan loam, 14 to 20 percent slopes, eroded.** This very deep, moderately steep, moderately well drained soil is on dissected, uneven side slopes. Individual areas are irregular in shape and range from about 25 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 3 inches; dark grayish brown, friable loam

*Subsoil:*
3 to 6 inches; strong brown, firm clay loam
6 to 16 inches; strong brown, very firm clay
16 to 29 inches; yellowish brown, very firm clay loam
29 to 49 inches; brown and yellowish brown, mottled, very firm clay loam
49 to 60 inches; light olive brown, very firm clay loam

In some areas the surface layer and the upper part of the subsoil have less sand and gravel.

Included with this soil in mapping are small areas of the frequently flooded Floris and Wilbur soils and the moderately deep Vanmeter soils. Floris and Wilbur soils are in drainageways. Vanmeter soils are in narrow bands low on the slopes adjacent to the Floris and Wilbur soils. Included soils make up about 4 to 6 percent of the unit.

Important properties of the Winnegan soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Low
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas of this soil are used for hay and pasture, but some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Erosion has resulted in the loss of one-half or more of the original topsoil. Many cultivated areas of this soil are being reseeded to grass to protect them from further erosion.

This soil is well suited to birdsfoot trefoil, crownvetch, red fescue, redtop, and switchgrass. It is moderately well suited to indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour farming minimize erosion. Timely preparation of the seedbed and establishing the seedbed on the contour promote the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage (fig. 9).

This soil is suited to trees, and some areas support native hardwoods. The main management concerns are

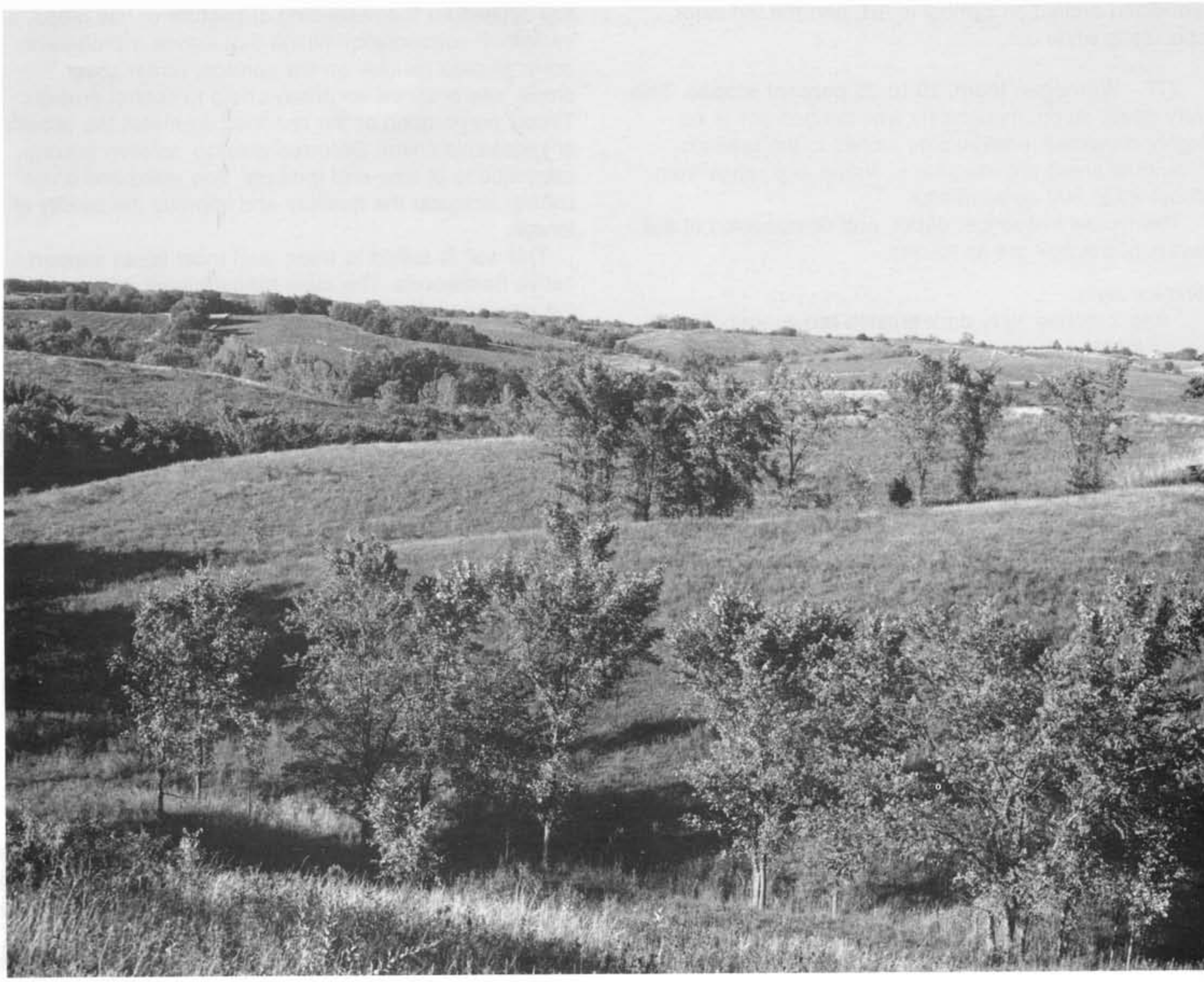

**Figure 9.—An area of Winnegan loam, 14 to 20 percent slopes, eroded, used as pasture. Control of weeds and brush is needed to keep areas of this soil from reverting to woodland.**

the equipment limitation and the hazard of erosion. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope and the slow permeability.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**27F—Winnegan loam, 20 to 35 percent slopes.** This very deep, steep, moderately well drained soil is on highly dissected, uneven side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 2 inches; very dark grayish brown, very friable loam

*Subsurface layer:*
2 to 6 inches; yellowish brown, friable loam

*Subsoil:*
6 to 16 inches; yellowish brown, firm clay
16 to 36 inches; yellowish brown, mottled, very firm clay and clay loam
36 to 41 inches; multicolored, firm clay loam

*Substratum:*
41 to 60 inches; dark yellowish brown and light brownish gray, mottled, firm clay loam

In some areas the surface layer and the upper part of the subsoil have less sand and gravel.

Included with this soil in mapping are small areas of the frequently flooded Floris and Wilbur soils and small areas of the moderately deep Vanmeter soils. Floris and Wilbur soils are on flood plains. Vanmeter soils are in narrow bands low on the slopes adjacent to the Floris and Wilbur soils. Included soils make up about 3 to 6 percent of the unit.

Important properties of the Winnegan soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Low
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are wooded. Some areas are used for pasture. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. It is suited to ladino clover, birdsfoot trefoil, red clover, tall fescue, timothy, crownvetch, red fescue, redtop, and switchgrass. It is moderately suited to orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and grassed waterways help to control erosion. Timely preparation of the seedbed promotes the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and most areas support native hardwoods. The main management concerns are the equipment limitation and the hazard of erosion. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope and the slow permeability.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**27F2—Winnegan loam, 20 to 35 percent slopes, eroded.** This very deep, steep, moderately well drained soil is on highly dissected, uneven side slopes in the uplands. Individual areas are irregular in shape and range from about 25 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 4 inches; dark brown and dark yellowish brown, friable loam

*Subsoil:*
4 to 28 inches; yellowish brown and dark yellowish brown, firm clay loam

*Substratum:*
28 to 60 inches; yellowish brown, dark yellowish brown, and grayish brown, mottled, firm loam

Included with this soil in mapping are small areas of the frequently flooded Floris and Wilbur soils and the moderately deep Vanmeter soils. Floris and Wilbur soils are on narrow flood plains. Vanmeter soils are in narrow bands low on the slopes. Included soils make up about 3 to 6 percent of the unit.

Important properties of the Winnegan soil—

*Permeability:* Slow
*Surface runoff:* Rapid
*Available water capacity:* Moderate
*Organic matter content:* Low
*Seasonal high water table:* Perched at a depth of 2.0 to 3.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for pasture. Some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Erosion has resulted in the loss of one-half or more of the original topsoil.

This soil is suited to ladino clover, birdsfoot trefoil, red clover, tall fescue, timothy, crownvetch, red fescue, redtop, and switchgrass. It is moderately suited to orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Erosion during seedbed preparation and overgrazing are the main management concerns. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and grassed waterways help to control erosion. Timely preparation of the seedbed promotes the growth of vegetative cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is suited to trees, and some areas support native hardwoods. The main management concerns are the equipment limitation and the hazard of erosion. Haul roads and skid trails should be established across the slope. Installing culverts and water breaks helps to control erosion. Thinning and selective cutting of undesirable trees are needed in most existing stands. Thinning and selective cutting can also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope and the slow permeability.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope limit the use of this soil as a site for local roads and streets. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is VIe. The woodland ordination symbol is 3R, and the indicator species is white oak.

**30B—Mexico silt loam, 1 to 3 percent slopes.** This very deep, very gently sloping, somewhat poorly drained soil is on broad divides in the uplands. Individual areas are irregular in shape and range from about 75 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 8 inches; very dark grayish brown, friable silt loam

*Subsurface layer:*
8 to 11 inches; dark grayish brown, mottled, friable silt loam

*Subsoil:*
11 to 15 inches; grayish brown, mottled, firm silty clay loam
15 to 36 inches; grayish brown, mottled, very firm silty clay
36 to 53 inches; light brownish gray, firm silty clay

*Substratum:*
53 to 60 inches; grayish brown, mottled, firm silty clay loam

In some areas the subsurface layer is thicker.

Important soil properties—

*Permeability:* Very slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 1.0 to 2.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material.

Erosion is a major hazard. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover. It is moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. The species that can withstand wetness grow best. Erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

**31—Putnam silt loam.** This very deep, nearly level, poorly drained soil is on broad divides in the uplands. Individual areas are irregular in shape and range from about 25 to 3,000 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 9 inches; very dark grayish brown, friable silt loam

*Subsurface layer:*
9 to 16 inches; grayish brown, mottled, friable silt loam

*Subsoil:*
16 to 22 inches; dark gray, mottled, firm silty clay
22 to 45 inches; grayish brown, mottled, firm silty clay
45 to 60 inches; grayish brown, mottled, firm silty clay loam

In some areas the subsurface layer is less than 6 inches thick.

Important soil properties—

*Permeability:* Very slow
*Surface runoff:* Slow
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 0.5 foot to 1.5 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust and puddle after periods of heavy rainfall. Wetness is the main management concern. Shallow surface ditches and land grading help to remove excess water. Applying a system of conservation tillage and harvesting while the soil is at the proper moisture content or while the soil is frozen help to retain soil structure and maintain internal drainage. Returning crop residue to the soil and regularly adding other organic material help to maintain the structure of the soil, improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is moderately well suited to birdsfoot trefoil and switchgrass. The species that can withstand wetness grow best. Deferred grazing, rotation grazing, and applications of lime and fertilizer increase the quantity and improve the quality of forage. Shallow surface ditches and land grading reduce the wetness that can damage plants.

This soil is suited to building site development. The wetness and the shrink-swell potential are severe limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

**32B—Adco silt loam, 1 to 3 percent slopes.** This very deep, very gently sloping, somewhat poorly drained soil is on ridgetops and side slopes that connect to the main upland divides. Individual areas are long and branching and range from about 50 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 8 inches; very dark gray, friable silt loam

*Subsurface layer:*
8 to 12 inches; grayish brown, mottled, friable silty clay loam

*Subsoil:*
12 to 16 inches; dark gray, mottled, firm clay
16 to 31 inches; yellowish brown and grayish brown, mottled, firm silty clay
31 to 46 inches; light brownish gray, mottled, firm silty clay loam

*Substratum:*
46 to 60 inches; light brownish gray, mottled, firm silty clay loam

In some areas the surface layer is silty clay loam.

Important soil properties—

*Permeability:* Very slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at a depth of 2 to 4 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. The hazard of erosion is moderate. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover. It is moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

**32B2—Adco silt loam, 1 to 3 percent slopes, eroded.** This very deep, very gently sloping, somewhat poorly drained soil is on ridgetops and side slopes of secondary upland divides. Individual areas are long and narrow and range from about 15 to 300 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 5 inches; dark grayish brown, friable silt loam

*Subsoil:*
5 to 15 inches; dark grayish brown, mottled, firm silty clay
15 to 32 inches; grayish brown, mottled, very firm silty clay
32 to 41 inches; grayish brown and light brownish gray, mottled, firm silty clay loam

*Substratum:*
41 to 60 inches; light brownish gray, mottled, firm silt loam

In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Leonard soils. These soils are on head slopes and concave side slopes below the Adco soil. They make up about 5 percent of the unit.

Important properties of the Adco soil—

*Permeability:* Very slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 2 to 4 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. A few areas are wooded. This soil is suited to corn (fig. 10), soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Erosion has resulted in the loss of about one-half of the original topsoil. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover. It is moderately well suited to alsike clover, birdsfoot trefoil, big bluestem, and indiangrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

Figure 10.—Corn shocks in an area of Adco silt loam, 1 to 3 percent slopes, eroded.

**40—Vesser silt loam, occasionally flooded.** This very deep, nearly level, poorly drained soil is on high flood plains. It is occasionally flooded for brief periods. Individual areas are long and narrow or irregular in shape. They range from about 15 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 12 inches; very dark gray, friable silt loam

*Subsurface layer:*
12 to 24 inches; dark gray, mottled, friable silt loam

*Subsoil:*
24 to 45 inches; very dark gray and dark gray, mottled, firm silty clay loam
45 to 60 inches; gray, mottled, friable silty clay loam

Included with this soil in mapping are small areas of the frequently flooded Chequest and Tice soils on the lower flood plains. These soils make up about 5 percent of the unit.

Important properties of the Vesser soil—

*Permeability:* Moderate
*Surface runoff:* Slow

*Available water capacity:* High
*Organic matter content:* Moderate
*Depth to a seasonal high water table:* 1 to 3 feet
*Shrink-swell potential:* Moderate
*Potential for frost action:* High

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Wetness is the main management concern. Constructing diversions at the base of adjacent upland slopes can keep excess water from flowing onto this soil. Surface drains also help to remove excess water.

This soil is suited to pasture and hay mixtures containing species that can withstand wetness, such as reed canarygrass and alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Proper stocking rates and timely deferment of grazing help to keep the pasture in good condition. Rotation grazing and applications of lime and fertilizer increase the quantity and improve the quality of forage.

This soil generally is not used for building site development because of the occasional flooding. If the soil is used for building site development, dwellings should be constructed on raised, well compacted fill material on sites that are above the level of flooding. Wetness and the shrink-swell potential are also limitations on sites for dwellings with basements. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and backfilling with sand and gravel. Installing drainage tiles around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforcement steel, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness. Properly constructed lagoons can function adequately if the berms are high enough to prevent overtopping by flooding. Also, sealing the berms and bottom of the lagoon with slowly permeable material helps to prevent seepage and the contamination of ground water.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the flooding limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by flooding, low strength, and shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

**41B—Marion silt loam, 1 to 3 percent slopes.** This very deep, very gently sloping, somewhat poorly drained soil is on stream terraces at the base of the more sloping uplands and above the flood plains. Individual areas are irregular in shape and range from about 5 to 30 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 9 inches; dark grayish brown, friable silt loam

*Subsurface layer:*
9 to 18 inches; brown, friable silt loam

*Subsoil:*
18 to 48 inches; yellowish brown and grayish brown, mottled, firm silty clay and silty clay loam

*Substratum:*
48 to 60 inches; grayish brown, mottled, firm silt loam

In some areas sand and fine gravel are in the surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the sloping Gorin soils. These soils generally are at the edges of the unit. They make up about 5 to 10 percent of the unit.

Important properties of the Marion soil—

*Permeability:* Very slow
*Surface runoff:* Slow
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 1 to 2 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. The hazard of erosion is moderate. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is a management concern. Timely tillage and a quickly established ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is suited to trees, but few areas are forested. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. Equipment should be used only when the soil is dry or frozen. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening the roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 2W, and the indicator species is white oak.

**42—Bremer silt loam, rarely flooded.** This very deep, nearly level, poorly drained soil is on low stream terraces. It is subject to rare flooding for very brief periods. Individual areas are irregular in shape and range from about 10 to 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 4 inches; very dark brown, friable silt loam

*Subsurface layer:*
4 to 18 inches; black and very dark gray, mottled, friable silt loam

*Subsoil:*
18 to 28 inches; very dark gray, mottled, very firm silty clay
28 to 60 inches; very dark gray and dark gray, mottled, very firm silty clay loam

In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the frequently flooded Chequest soils on flood plains at the lower edges of the unit. These soils make up less than 5 percent of the unit.

Important properties of the Bremer soil—

*Permeability:* Moderately slow
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* High
*Depth to a seasonal high water table:* 1 to 2 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Wetness is the main management concern. Constructing diversions at the base of adjacent upland slopes can keep excess water from flowing onto this soil. Shallow surface ditches and land grading help to remove excess water.

This soil is suited to pasture and hay mixtures containing species that can withstand wetness, such as reed canarygrass and alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Proper stocking rates and timely deferment of grazing help to keep the pasture in good condition. Rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. Trees should be harvested during periods when the soil is firm and dry or is frozen. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard and maximize growth potential.

This soil generally is not used for building site development because of the flooding. Building sites should be selected in areas above the level of flooding. Wetness, the flooding, and the shrink-swell potential are the main limitations on sites for dwellings. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and backfilling with sand and gravel. Reinforcement steel, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling. Constructing dwellings without basements on raised, well compacted fill material and installing drainage tile around footings and foundations help to prevent the damage caused by excessive wetness or by flooding.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the moderately slow permeability. Properly constructed lagoons can function adequately if the berms are high enough to prevent overtopping by flooding. Also, sealing the berms and bottom of the lagoons with slowly permeable material helps to prevent seepage and the contamination of ground water.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. The woodland ordination symbol is 7W, and the indicator species is eastern cottonwood.

**43—Chariton silt loam.** This very deep, nearly level, poorly drained soil is on high stream terraces above the adjacent flood plains and below the sloping uplands. Individual areas are irregular in shape and range from about 10 to 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 9 inches; very dark grayish brown, very friable silt loam

*Subsurface layer:*
9 to 15 inches; grayish brown, mottled, friable silt loam

*Subsoil:*
15 to 18 inches; grayish brown, mottled, friable silty clay loam
18 to 22 inches; grayish brown, dark grayish brown, and dark gray, mottled, very firm silty clay
22 to 37 inches; dark grayish brown, mottled, very firm silty clay
37 to 46 inches; dark grayish brown, mottled, firm silty clay loam

*Substratum:*
46 to 60 inches; yellowish brown, gray, and strong brown, mottled, firm sandy clay loam

In some areas the subsurface layer is less than 4 inches thick.

Important soil properties—

*Permeability:* Slow
*Surface runoff:* Slow
*Available water capacity:* Moderate
*Organic matter content:* Moderate
*Seasonal high water table:* Perched at the surface to 1.5 feet below the surface
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Wetness is the main management concern. Constructing diversions at the base of adjacent upland slopes can keep excess water from flowing onto this soil. Shallow surface ditches and land grading help to remove excess water.

This soil is suited to pasture and hay mixtures containing species that can withstand wetness, such as reed canarygrass and alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Proper stocking rates and timely deferment of grazing help to keep the pasture in good condition. Rotation grazing and applications of lime and fertilizer increase the quantity and improve the quality of forage.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and backfilling with sand and gravel. Constructing dwellings on raised, well compacted fill material and installing drainage tile around footings and foundations help to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

**44B—Gifford silt loam, 2 to 5 percent slopes.** This very deep, gently sloping, poorly drained soil is on the lower side slopes of high stream terraces adjacent to the flood plain. Individual areas are irregular in shape and range from about 15 to 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 7 inches; very dark grayish brown, friable silt loam

*Subsoil:*
7 to 10 inches; dark grayish brown, firm silty clay loam
10 to 24 inches; dark gray, mottled, firm silty clay
24 to 39 inches; grayish brown and gray, mottled, firm silty clay
39 to 60 inches; gray, mottled, friable silty clay loam

In some areas the subsurface layer is grayish brown silt loam. In other areas sand and gravel are in the surface layer and the upper part of the subsoil.

Important soil properties—

*Permeability:* Very slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 0.5 foot to 2.0 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. The hazard of erosion is severe. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is suited to pasture and hay mixtures containing species that can withstand wetness, such as alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

**44C2—Gifford silt loam, 5 to 9 percent slopes, eroded.** This very deep, moderately sloping, poorly drained soil is on the lower side slopes of high stream terraces adjacent to the flood plain. Individual areas are irregular in shape and range from about 15 to 50 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 5 inches; very dark grayish brown, friable silt loam

*Subsoil:*
5 to 7 inches; grayish brown, mottled, friable silty clay
7 to 10 inches; dark gray, mottled, firm silty clay
10 to 33 inches; gray and grayish brown, mottled, very firm silty clay loam

*Substratum:*
33 to 60 inches; multicolored, firm silt loam

In some areas the subsurface layer is grayish brown silt loam. In other areas sand and gravel are in the surface layer and the upper part of the subsoil.

Included with this soil in mapping are small areas of the frequently flooded Blackoar and Chequest soils and areas of soils on short, steep slopes at the lower edges of the unit. Included areas make up about 4 to 10 percent of the unit.

Important properties of the Gifford soil—

*Permeability:* Very slow
*Surface runoff:* Medium
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Seasonal high water table:* Perched at a depth of 0.5 foot to 2.0 feet
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Erosion has resulted in the loss of one-half or more of the original topsoil. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete in basement walls, foundations, and footings and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing drainage tile around footings and underneath basement floors helps to prevent the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the very slow permeability. Properly constructed lagoons can function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

**45A—Moniteau silt loam, occasionally flooded, 0 to 3 percent slopes.** This very deep, nearly level and very gently sloping, poorly drained soil is on high flood plains. It is occasionally flooded for brief periods. Individual areas are irregular in shape and range from about 5 to 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 9 inches; grayish brown and brown, very friable silt loam

*Subsurface layer:*
9 to 22 inches; light brownish gray, mottled, very friable silt loam

*Subsoil:*
22 to 28 inches; grayish brown, mottled, firm silty clay loam
28 to 41 inches; dark grayish brown, mottled, firm silty clay loam
41 to 60 inches; dark gray, mottled, firm silt loam

In some areas the soil has more sand and less clay.

Included with this soil in mapping are small areas of the frequently flooded Piopolis and Wilbur soils in the slightly lower landscape positions adjacent to natural stream channels. Included soils make up less than 8 percent of the unit.

Important properties of the Moniteau soil—

*Permeability:* Moderately slow
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* Moderately low
*Seasonal high water table:* At the surface to 1 foot below the surface
*Shrink-swell potential:* Moderate
*Potential for frost action:* High

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a growing crop or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Using shallow surface ditches, land grading, and tilling only at the optimum moisture content reduce wetness and improve crop production. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, and increase the available water capacity and the rate of water infiltration.

A few small areas are used for hay and pasture. This soil is moderately well suited to tall fescue, timothy, birdsfoot trefoil, red clover, and switchgrass. It is moderately suited to big bluestem. Wetness is the main management concern. The species that can withstand wetness grow best. A drainage system is beneficial, especially if deep-rooted species are planted. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and some areas support small stands of native hardwoods. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. Harvest equipment should be used only when the topsoil is dry and firm or when the soil is frozen. Seedling mortality is caused by wetness or by droughtiness during dry summer periods. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard and maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness, the shrink-swell potential, and the moderately slow permeability also are severe limitations.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by flooding, low strength, and shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 4W, and the indicator species is pin oak.

**46B—Vigar loam, rarely flooded, 2 to 5 percent slopes.** This very deep, gently sloping, moderately well drained soil is on toe slopes at the base of the uplands and adjacent to the flood plain. It is subject to rare flooding for very brief periods. Individual areas are irregular in shape and range from about 15 to 50 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 7 inches; very dark gray, friable loam

*Subsurface layer:*
7 to 20 inches; very dark gray, friable loam

*Subsoil:*
20 to 26 inches; dark grayish brown, friable loam
26 to 34 inches; dark grayish brown and brown, mottled, friable loam
34 to 60 inches; dark grayish brown, gray, and brown, mottled, firm silty clay loam

In some areas the surface layer and the upper part of the subsoil are silt loam.

Important soil properties—

*Permeability:* Moderately slow
*Surface runoff:* Medium
*Available water capacity:* High
*Organic matter content:* Moderate
*Depth to a seasonal high water table:* 2 to 3 feet
*Shrink-swell potential:* Moderate
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. The hazard of erosion is moderate. Practices that minimize erosion and sustain production on this soil include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets, grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover. It is moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. The species that can withstand wetness grow best. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil generally is not used for building site development because of the wetness and the flooding. The shrink-swell potential is a severe limitation on sites for dwellings. If this soil is used for building site development, dwellings should be constructed on raised, well compacted fill material on sites that are above the level of flooding. Installing drainage tile around footings and foundations minimizes the damage caused by excessive wetness. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and backfilling with sand and gravel. Reinforcement steel, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil generally is not used for septic tank absorption fields because of the wetness and the moderately slow permeability. Properly constructed lagoons can function adequately if the site can be leveled. Also, sealing the berms and bottom of the lagoon with slowly permeable material helps to prevent seepage.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material minimizes the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

**51—Wilbur silt loam, frequently flooded.** This very deep, nearly level, moderately well drained soil is on low flood plains along small streams. It is frequently flooded for brief periods. Individual areas are long and narrow and range from about 25 to 125 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 8 inches; brown, very friable silt loam

*Substratum:*
8 to 36 inches; brown and pale brown, mottled, friable silt loam
36 to 60 inches; grayish brown and brown, mottled, friable silt loam

In some areas, the subsoil is not mottled and more sand is in the substratum.

Included with this soil in mapping are small areas of the poorly drained Moniteau and Piopolis soils. Moniteau soils are at the slightly higher elevations at the base of the uplands. Piopolis soils are in low areas on the flood plains. Included soils make up about 8 percent of the unit.

Important properties of the Wilbur soil—

*Permeability:* Moderate
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* Moderately low
*Depth to a seasonal high water table:* 1.5 to 3.0 feet
*Shrink-swell potential:* Low
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Flooding is the main management concern. It delays planting or interferes with harvesting and causes moderate damage to crops during some years. However, summer annual crops commonly are planted and harvested with only minor damage. It may be necessary to harvest only when the ground is frozen because of the equipment limitation.

This soil is moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main management concern. Plants that can withstand wetness and flooding grow best. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity of forage, improve the quality of forage, and help to control erosion.

This soil is suited to trees, and a few small areas support native hardwoods. Planting and harvesting can be scheduled to avoid periods of flooding. Selective cutting and timely harvesting of mature trees maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness also is a limitation.

The flooding, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage caused by flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. The woodland ordination symbol is 4A, and the indicator species is green ash.

**52—Blackoar silt loam, frequently flooded.** This very deep, nearly level, poorly drained soil is on the flood plains along small tributary streams. It is frequently flooded for brief periods. Individual areas are generally long and narrow and range from about 20 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 10 inches; very dark gray, friable silt loam

*Subsurface layer:*
10 to 16 inches; very dark gray, friable silt loam

*Subsoil:*
16 to 42 inches; gray and dark gray, mottled, friable silt loam

*Substratum:*
42 to 60 inches; gray and dark gray, mottled, friable silt loam and firm silty clay loam

In some areas, the subsurface layer is dark gray and the subsoil has more clay.

Important soil properties—

*Permeability:* Moderate
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* Moderate
*Seasonal high water table:* At the surface to 1 foot below the surface
*Shrink-swell potential:* Low
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. Some areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Flooding delays planting and interferes with harvesting in some years. The flooding commonly is of short duration, however, and crop damage is minimal. Constructing diversions at the base of foot slopes in the uplands or on stream terraces can keep excess water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration. In some years fall harvesting may be delayed until the ground is frozen.

This soil is moderately suited to alsike clover. The wetness and the flooding are the main management concerns. Plants that can withstand wetness and flooding grow best. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. Some small narrow areas on flood plains support native hardwoods. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. Planting and harvesting can be scheduled to avoid periods of flooding and wetness. The trees should be harvested only during periods when the soil is dry or frozen. Seedling mortality is caused by wetness. Planting container-grown nursery stock or reinforcement planting during early spring increases the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard and maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness also is a limitation.

The flooding, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material minimizes the damage caused by flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 4W, and the indicator species is pin oak.

**53—Chequest silty clay loam, occasionally flooded.** This very deep, nearly level, poorly drained soil is in low areas along small streams and on low, broad flood plains along large streams. It is occasionally flooded for brief periods. In some places it is protected from flooding by levees. Individual areas are irregular in shape and range from about 50 to 300 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 10 inches; very dark gray, firm silty clay loam

*Subsoil:*
10 to 24 inches; dark gray, mottled, firm silty clay loam
24 to 32 inches; dark gray and very dark gray, mottled, firm silty clay loam
32 to 60 inches; dark gray and gray, mottled, very firm silty clay loam

In some areas the soil has less clay throughout.

Important soil properties—

*Permeability:* Moderately slow
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* Moderate
*Depth to a seasonal high water table:* 1 to 3 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops. Some areas are used for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. If the surface is not protected by a growing crop or surface mulch, it tends to crust or puddle after periods of heavy rainfall. Flooding delays planting and interferes with harvesting during most years and commonly damages crops. A drainage system is needed. Shallow surface ditches and land grading can improve surface drainage if adequate outlets are available. Extremely wet areas also can be improved by land grading and shaping. Constructing diversions at the base of foot slopes in the uplands or on stream terraces can keep excess water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration. In some years fall harvesting may be delayed until the ground is frozen.

This soil is best suited to pasture and hay mixtures containing species that can withstand wetness and flooding, such as reed canarygrass and alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table and the flooding. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. Planting and harvesting can be scheduled to avoid periods of flooding and wetness. The trees should be harvested only during periods when the soil is dry or frozen. Seedling mortality is caused by wetness. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard and maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness and the shrink-swell potential also are limitations.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable material minimize the damage that may be caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 7W, and the indicator species is eastern cottonwood.

**55—Piopolis silty clay loam, frequently flooded.** This very deep, nearly level, poorly drained soil is on low flood plains along large streams. It is frequently flooded for brief periods. Individual areas are irregular in shape and range from 50 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 9 inches; dark grayish brown and dark gray, mottled, firm silty clay loam

*Substratum:*
9 to 30 inches; grayish brown and gray, mottled, firm silty clay loam
30 to 49 inches; dark gray and grayish brown, mottled, firm silty clay loam
49 to 60 inches; light brownish gray, firm silty clay loam

In some areas the soil has more clay throughout. In other areas the soil has a gray subsurface horizon. A few small areas are subject to ponding.

Important soil properties—

*Permeability:* Slow
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* Moderately low
*Seasonal high water table:* At the surface to 3 feet below the surface
*Shrink-swell potential:* Moderate
*Potential for frost action:* High

Most areas are used for cultivated crops. Some areas are used for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. If the surface layer is not protected by a growing crop or surface mulch, it tends to crust or puddle after periods of heavy rainfall. Flooding and wetness are the main management concerns. The flooding delays planting and interferes with harvesting during most years and commonly damages crops. A drainage system is needed. Shallow surface ditches and land grading can improve surface drainage if adequate outlets are available. Extremely wet areas also can be improved by land grading and shaping. Constructing diversions at the base of foot slopes in the uplands or on stream terraces can keep excess water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration. If flooding interferes with harvesting in the fall, it may be necessary to delay harvesting until the ground is frozen.

This soil is best suited to pasture and hay mixtures containing species that can withstand wetness and flooding, such as reed canarygrass and alsike clover. A surface drainage system benefits deep-rooted species. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table and the flooding. The soil is poorly suited to hay production. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and some low areas support native hardwoods. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. Planting and harvesting can be scheduled to avoid periods of flooding and wetness. The trees should be harvested only during periods when the soil is firm and dry or is frozen. Seedling mortality is caused by wetness. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard and maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness and the shrink-swell potential also are limitations.

Ponding, the flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by ponding, flooding, and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 5W, and the indicator species is pin oak.

**56—Darwin silty clay, occasionally flooded.** This very deep, nearly level, poorly drained soil is on low flood plains along large streams and some smaller tributaries. Most areas are protected by channels and levees but are occasionally flooded by local tributaries or levee breaks. This soil also is subject to ponding for brief or long periods. Individual areas are irregular in shape and range from 50 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*

0 to 11 inches; very dark gray, firm silty clay

*Subsoil:*

11 to 22 inches; very dark gray, mottled, firm silty clay

22 to 45 inches; dark gray, mottled, firm silty clay

*Substratum:*

45 to 60 inches; gray, mottled, firm silty clay loam

Included with this soil in mapping are small areas of frequently flooded soils. These soils generally are along the smaller tributaries. They make up about 5 percent of the unit.

Important properties of the Darwin soil—

*Permeability:* Very slow
*Surface runoff:* Very slow
*Available water capacity:* Moderate
*Organic matter content:* High
*Seasonal high water table:* 1 foot above to 2 feet below the surface
*Shrink-swell potential:* Very high
*Potential for frost action:* Moderate

Most areas are used for cultivated crops. Some areas are used for hay and pasture. This soil generally is suited to cultivated crops. Corn, soybeans, winter wheat, and grain sorghum are the most commonly grown crops. Wetness delays planting and interferes with harvesting during most years. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. The very slow surface runoff rate and very poor internal drainage make it difficult to remove excess water from cultivated areas. Shallow surface ditches and land grading can improve surface drainage if adequate outlets are available. Constructing diversions at the base of foot slopes in the uplands or on stream terraces can keep excess water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration. Fall tillage can improve tilth in the surface layer and usually allows earlier seeding in the spring. Crops are commonly damaged by flooding in a few areas, but the damage is not a major concern during the summer growing season. If flooding interferes with harvesting in the fall, it may be necessary to delay harvesting until the ground is frozen.

This soil is best suited to pasture and hay mixtures containing species that can withstand wetness and flooding, such as reed canarygrass and alsike clover. It is moderately well suited to reed canarygrass and is moderately suited to ladino clover and birdsfoot trefoil. A surface drainage system benefits deep-rooted species. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table and the flooding. This soil is poorly suited to hay production. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and some areas support native hardwoods. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. Planting and harvesting can be scheduled to avoid periods of flooding and wetness. The trees should be harvested only during periods when the soil is firm and dry or is frozen. Seedling mortality is caused by wetness. Reinforcement planting during early spring while seedlings are dormant and controlling or removing competing vegetation increase the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard and maximize growth potential.

This soil is not suited to building site development or onsite waste disposal because of the flooding and the wetness.

Ponding, the flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by ponding, flooding, and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 4W, and the indicator species is pin oak.

**57—Floris loam, frequently flooded.** This very deep, nearly level, moderately well drained soil is on low flood plains along small streams. It is frequently flooded for brief periods. Individual areas are long and narrow and range from about 10 to 50 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 13 inches; dark grayish brown, very friable loam

*Substratum:*
13 to 17 inches; dark grayish brown, mottled, very friable fine sandy loam
17 to 30 inches; brown, mottled, friable fine sandy loam
30 to 60 inches; brown, mottled, friable silt loam

In some areas the surface layer and substratum are very dark grayish brown. In other areas the soil has more clay throughout.

Important soil properties—

*Permeability:* Moderate
*Surface runoff:* Slow
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Depth to a seasonal high water table:* 3 to 6 feet
*Shrink-swell potential:* Low
*Potential for frost action:* Moderate

Most areas are used for hay and pasture or as woodland. Some areas are used for cultivated crops. Areas of this soil that are large enough to farm are suited to cultivated crops. Corn, soybeans, winter wheat, and grain sorghum are the most commonly grown crops. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Flooding delays planting and interferes with harvesting during some years, but summer annual crops commonly receive only minor damage.

This soil is well suited to alsike clover. It is moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main management concern. Plants that can withstand wetness and flooding grow best. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness also is a limitation.

The flooding and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material minimizes the damage caused by flooding and by frost action. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 3A, and the indicator species is white oak.

**58—Excello silt loam, frequently flooded.** This very deep, nearly level, poorly drained soil is in low areas on narrow flood plains along small streams and drainageways. It is frequently flooded for brief periods. Individual areas are irregular in shape and range from about 10 to 60 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 13 inches; very dark gray, very friable silt loam

*Subsurface layer:*
13 to 18 inches; black, friable loam

*Subsoil:*
18 to 43 inches; black, friable loam
43 to 60 inches; very dark gray, friable loam

In some areas the surface layer and subsoil are dark gray. Some areas are only rarely or occasionally flooded.

Important soil properties—

*Permeability:* Moderate
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* Moderate
*Depth to a seasonal high water table:* 1 to 3 feet
*Shrink-swell potential:* Moderate
*Potential for frost action:* High

Most areas are used for hay and pasture or as woodland. Some areas are used for cultivated crops. Areas of this soil that are large enough to be farmed are suited to row crops. Corn, soybeans, winter wheat, and grain sorghum are the most commonly grown crops. The surface layer is friable and can be easily tilled within a moderate range in moisture content.

Flooding delays planting and interferes with harvesting during most years and commonly damages crops. A drainage system is needed. Shallow surface ditches and land grading can improve surface drainage if adequate outlets are available. Extremely wet areas also can be improved by land grading and shaping. Constructing diversions at the base of foot slopes in the uplands or on stream terraces can keep excess water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration.

This soil is best suited to pasture and hay mixtures containing species that can withstand wetness and flooding. It is moderately suited to alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table and the flooding. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness and the shrink-swell potential also are limitations.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. No woodland ordination symbol is assigned.

**60E—Lenzburg clay loam, 9 to 20 percent slopes, very stony.** This very deep, strongly sloping and moderately steep, well drained soil is on ridgetops in the uplands and on side slopes in areas that have been surface mined for coal. It formed in material that was excavated during surface mining activities and was then graded and shaped. The fine-earth portion is mainly glacial till material. Individual areas generally are irregular in shape and range from about 20 to 500 acres in size. Stones cover about 0.2 to 0.5 percent of the surface.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 3 inches; grayish brown, friable clay loam

*Substratum:*
3 to 60 inches; multicolored, firm clay loam

In some areas the substratum is channery.

Included with this soil in mapping are areas that have a mixture of acid shale and coal. These areas are toxic to most plants because of acidity. They make up less than 5 percent of the unit.

Important properties of the Lenzburg soil—

*Permeability:* Moderately slow
*Surface runoff:* Rapid
*Available water capacity:* Low
*Organic matter content:* Very low
*Depth to a seasonal high water table:* More than 6 feet
*Shrink-swell potential:* Moderate
*Potential for frost action:* Moderate

Most areas are used for pasture and hay, but a few small areas have been planted to trees. This soil is unsuited to cultivated crops because of the hazard of erosion, surface stoniness, cables and other steel objects buried within the plow zone, and in some places the low fertility and acid condition of the root zone. The slope limits the use of equipment in some areas.

This soil is best suited to pasture and hay mixtures containing species that can withstand a wide range in reaction and a limited rooting depth. If the pasture is overgrazed or is cultivated during seedbed preparation, the hazard of erosion is very severe. If the soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour farming minimize erosion. Timely tillage and a quickly established ground cover also help to control erosion. Using a ground cover and a surface mulch reduces the runoff rate, reduces the hazard of erosion, and increases the rate of water infiltration.

A few small areas, especially on the steeper slopes, have been planted to hardwoods. If this soil is used as woodland, species that can tolerate a wide range in soil reaction should be selected. The main management concerns are the equipment limitation and the hazard of erosion. Building haul roads on the contour and constructing water breaks help to control erosion. The use of equipment is sometimes restricted because the soil is soft and slippery when wet. Equipment should be used only when the soil is dry or frozen. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting of mature trees maximize growth potential.

The less sloping areas of this unit are suited to building site development. The unstable fill and the shrink-swell potential are limitations on sites for dwellings. The damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls. Installing drainage tiles around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways minimize the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the moderately slow permeability and the potential for settling and piping through unstable fill. It is poorly suited to sewage lagoons because of the unstable fill and the slope. Septic tank absorption fields and sewage lagoons should be established in areas of adjacent soils that are better suited to these uses.

The unstable fill, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Onsite testing, stripping the fill, constructing roads on raised, well compacted fill material, and strengthening the base with crushed rock or other suitable base material minimize the damage caused by the unstable fill. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by shrinking and swelling and by frost action. Designing roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is VIe. The woodland ordination symbol is 5R, and the indicator species is black walnut.

**60F—Lenzburg clay loam, 35 to 70 percent slopes, very stony.** This very deep, very steep, well drained soil consists of mine spoil in areas that have been surface mined for coal. This soil is a mixture of rock fragments and partially weathered fine-earth material that was in or below the profile of the original soil. The fine-earth portion is mainly glacial till material that has been severely altered by mining equipment. Most areas have not been graded or smoothed. Slopes generally are rough and uneven. Individual areas are irregular in shape and range from about 100 to 1,000 acres in size. Stones cover about 0.2 to 0.5 percent of the surface.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 14 inches; dark grayish brown, friable clay loam

*Substratum:*
14 to 60 inches; multicolored, firm and very firm clay loam and loam

In some areas the substratum is channery clay loam.

Included with this soil in mapping are areas that have a mixture of acid shale and coal. These areas are toxic to most plants because of acidity. Also included are long, narrow, intermittent or perennial ponds in abandoned pits. Included areas make up about 10 percent of the unit.

Important properties of the Lenzburg soil—

*Permeability:* Moderately slow
*Surface runoff:* Very rapid
*Available water capacity:* Low
*Organic matter content:* Very low
*Depth to a seasonal high water table:* More than 6 feet
*Shrink-swell potential:* Moderate
*Potential for frost action:* Moderate

Most areas of this soil are reverting to poor-quality timber and shrubs. If the soil is leveled and shaped, some grasses and legumes can be grown for pasture. This soil is unsuited to cultivated crops because of the slope, droughtiness, and a very severe hazard of erosion.

This soil generally is not used for pasture and hay because of the slope, droughtiness, and the very severe hazard of erosion. The depth of the root zone varies within a short distance because the density of the soil material is variable.

This soil is best suited to tree species that can tolerate alkaline soil conditions. The use of equipment is restricted because of the slope and because the soil is soft and slippery when wet. Hand planting of seedlings is necessary because of the slope.

The water-filled pits provide habitat for wetland wildlife. Commonly, the supply of water and food is adequate to support many species of desirable fish. The spoil areas around the excavated pits support some species of forbs, shrubs, and trees (fig. 11).

This soil generally is not used for building site development, septic tank absorption fields, sewage lagoons, or local roads and streets because of the slope and the unstable fill.

The land capability classification is VIIe. The woodland ordination symbol is 5R, and the indicator species is black walnut.

Figure 11.—A typical area of Lenzburg clay loam, 35 to 70 percent slopes, very stony.

**63B—Zook silty clay loam, occasionally flooded, channeled, 1 to 5 percent slopes.** This very deep, very gently sloping and gently sloping, poorly drained soil is on toe slopes and narrow flood plains along small streams and drainageways. It is occasionally flooded. Individual areas are irregular in shape and range from about 15 to 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 8 inches; black, friable silty clay loam

*Subsurface layer:*
8 to 36 inches; black and very dark gray, friable silty clay loam

*Subsoil:*
36 to 60 inches; very dark gray and dark gray, firm silty clay loam

In some areas the soil has less clay in the surface layer and subsoil.

Included with this soil in mapping are small areas of the frequently flooded, poorly drained Excello soils in the slightly lower landscape positions adjacent to natural stream channels. These soils make up less than 10 percent of the unit.

Important properties of the Zook soil—

*Permeability:* Slow
*Surface runoff:* Slow

*Available water capacity:* Moderate
*Organic matter content:* High
*Seasonal high water table:* At the surface to 2 feet below the surface
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for hay and pasture. Some of the larger areas are used for cultivated crops, such as corn, soybeans, winter wheat, and grain sorghum. Wetness is the main management concern. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. Timely tillage is necessary for the best crop production. Returning crop residue to the soil improves fertility and maintains tilth. Summer crops generally are not damaged by flooding.

This soil is moderately well suited to tall fescue, timothy, birdsfoot trefoil, red clover, and switchgrass. It is moderately suited to big bluestem. Wetness is the main management concern. The species that can withstand wetness grow best. A drainage system is beneficial, especially if deep-rooted species are grown. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is unsuited to building site development and onsite waste disposal because of the flooding and the wetness.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. No woodland ordination symbol is assigned.

**65—Dockery silt loam, occasionally flooded.** This very deep, nearly level, somewhat poorly drained soil is on flood plains along large streams. It is occasionally flooded. Individual areas are irregular in shape and range from about 25 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 12 inches; dark brown and dark grayish brown, friable silt loam

*Substratum:*
12 to 60 inches; brown, mottled, friable silt loam and loam

In some places the soil has more sand throughout.

Included with this soil in mapping are small areas of the poorly drained Chequest soils in low areas and at the edges of the unit. These soils make up about 7 percent of the unit.

Important properties of the Dockery soil—

*Permeability:* Moderate
*Surface runoff:* Slow
*Available water capacity:* Very high
*Organic matter content:* Moderate
*Depth to a seasonal high water table:* 2 to 3 feet
*Shrink-swell potential:* Moderate
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderately wide range in moisture content. Flooding delays planting and interferes with harvesting during some years, but summer annual crops commonly receive only minor damage.

This soil is well suited to reed canarygrass. It is moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main management concern. Plants that can withstand wetness grow best. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and a few small areas support native hardwoods. There are no major management concerns. Selective cutting and timely harvesting of mature trees maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness and the shrink-swell potential also are limitations.

Low strength, the flooding, the wetness, the shrink-swell potential, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by shrinking and swelling, low strength, and flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. The woodland ordination symbol is 4A, and the indicator species is pin oak.

**66—Tice silty clay loam, frequently flooded.** This very deep, nearly level, somewhat poorly drained soil is on flood plains along medium-sized and large streams. It is frequently flooded for brief periods. Individual areas are long and narrow and range from about 25 to 125 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 9 inches; very dark gray, friable silty clay loam

*Subsurface layer:*
9 to 13 inches; very dark gray, mottled, friable silty clay loam

*Subsoil:*
13 to 28 inches; dark grayish brown, mottled, friable silt loam

*Substratum:*
28 to 43 inches; grayish brown, brown, and dark brown, friable silt loam
43 to 60 inches; stratified dark grayish brown and grayish brown, mottled, friable silt loam

In some areas the soil has more sand in the surface layer and substratum.

Included with this soil in mapping are small areas of the poorly drained Vesser, Excello, and Piopolis soils. Vesser soils are at the slightly higher elevations at the base of the uplands. Excello and Piopolis soils are in low areas on the flood plain. Included soils make up about 10 percent of the unit.

Important properties of the Tice soil—

*Permeability:* Moderate
*Surface runoff:* Medium
*Available water capacity:* High
*Organic matter content:* Moderate
*Depth to a seasonal high water table:* 1.5 to 3.0 feet
*Shrink-swell potential:* Low
*Potential for frost action:* High

Most areas are used for cultivated crops or for hay and pasture. Some areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. Flooding delays planting and interferes with harvesting during most years, but summer annual crops commonly receive only minor damage.

This soil is moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main management concern. Plants that can withstand wetness and flooding grow best. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees, and a few small areas support native hardwoods. There are no major management concerns. Planting and harvesting can be scheduled to avoid periods of flooding. Selective cutting and timely harvesting of mature trees maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding. The wetness also is a limitation.

Low strength, the flooding, the wetness, the shrink-swell potential, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by shrinking and swelling, low strength, and flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIIw. The woodland ordination symbol is 5A, and the indicator species is pin oak.

**67—Aquents, frequently flooded.** These very poorly drained soils are in areas that are ponded for long periods or, because of downstream structures, are frequently flooded for long periods. Individual areas are irregular in shape and range from about 10 to 150 acres in size.

These soils vary greatly in composition. The typical sequence, depth, and composition of the layers of these soils are as follows—

*Surface layer:*
0 to 7 inches; very dark gray and dark gray, mottled, friable silt loam

*Subsurface layer:*
7 to 14 inches; grayish brown, mottled, friable silt loam

*Substratum:*
14 to 25 inches; dark gray, mottled, firm silty clay loam
25 to 52 inches; very dark grayish brown, mottled, firm silty clay loam
52 to 60 inches; dark gray, mottled, firm loam

Figure 12.—An area of Aquents, frequently flooded. These soils are well suited to wetland wildlife habitat.

Included in mapping are areas of soils that are flooded or ponded more than 50 percent of the year. Most of these areas are small, but a few are large.

Important properties of the Aquents—

*Permeability:* Slow
*Surface runoff:* Very slow
*Available water capacity:* High
*Organic matter content:* Moderate
*Seasonal high water table:* 3 feet above to 1 foot below the surface
*Shrink-swell potential:* High
*Potential for frost action:* Moderate

These soils support a mixture of grasses, weeds, wetland plants, and underbrush. Establishing a good stand of grass is difficult because standing water is on the surface at different times of the year. The soils are poorly suited to woodland. In most areas they are best suited to wetland wildlife habitat (fig. 12).

These soils are unsuited to building site development, onsite sewage disposal, and local roads and streets because of the flooding.

The land capability classification is VIIw. No woodland ordination symbol is assigned.

**68—Bremer loam, occasionally flooded, overwash.** This very deep, nearly level, somewhat poorly drained soil is on high flood plains along small to large streams. It is occasionally flooded for very brief periods. Individual areas are long and narrow and range from about 25 to 125 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 11 inches; very dark grayish brown and dark brown, very friable loam

*Substratum:*
11 to 18 inches; layers of very dark grayish brown to pale brown, mottled, very friable loam

*Buried surface layer:*
18 to 27 inches; very dark grayish brown, very dark gray, and black, mottled, friable silt loam and silty clay loam

*Buried subsoil:*
27 to 60 inches; black and very dark gray, firm silty clay loam

Included with this soil in mapping are small areas of the frequently flooded Chequest soils. These soils are at the slightly lower elevations and are closer to the stream channel than the Bremer soil. They make up about 10 percent of the unit.

Important properties of the Bremer soil—

*Permeability:* Moderately slow
*Surface runoff:* Slow
*Available water capacity:* High
*Organic matter content:* High
*Depth to a seasonal high water table:* 1 to 2 feet
*Shrink-swell potential:* High
*Potential for frost action:* High

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is very friable and can be easily tilled within a moderate range in moisture content. Wetness and flooding are the main management concerns. Planting and harvesting may be delayed in some years because of the flooding. Some damage to crops can be expected, but the damage generally is minimal for short-season summer crops. Constructing diversions at the base of adjacent upland slopes can keep excess water from flowing onto this soil. Shallow surface ditches help to remove excess water.

This soil is suited to pasture and hay mixtures containing species that can withstand wetness. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table. Proper stocking rates and timely deferment of grazing help to keep the pasture in good condition. Rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is suited to trees. The main management concerns are the equipment limitation, seedling mortality, and the windthrow hazard. The trees should be harvested only during periods when the soil is firm and dry or is frozen. Planting container-grown nursery stock or reinforcement planting during early spring while seedlings are dormant increases the seedling survival rate. Selective cutting and timely harvesting of mature trees reduce the windthrow hazard and maximize growth potential.

This soil is unsuited to building site development and onsite waste disposal because of the flooding.

Low strength, the flooding, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by shrinking and swelling, low strength, and flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by wetness and by frost action.

The land capability classification is IIw. The woodland ordination symbol is 7W, and the indicator species is eastern cottonwood.

**69—Floris silt loam, occasionally flooded.** This very deep, nearly level, moderately well drained soil is on flood plains along the Chariton River near the original stream channel. It is subject to occasional flooding for brief periods. Individual areas are irregular in shape and range from about 15 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

*Surface layer:*
0 to 13 inches; dark grayish brown and very dark grayish brown, friable silt loam

*Substratum:*
13 to 20 inches; stratified brown and dark brown, friable silt loam
20 to 40 inches; stratified dark brown and brown, mottled, friable loam

40 to 60 inches; stratified brown and dark grayish brown, mottled, friable loam and silt loam

In some areas the substratum is not mottled.

Included with this soil in mapping are small areas of the poorly drained Chequest soils in depressions and low areas away from the stream channel. These soils make up about 6 percent of the unit.

Important properties of the Floris soil—

*Permeability:* Moderate
*Surface runoff:* Slow
*Available water capacity:* Moderate
*Organic matter content:* Moderately low
*Depth to a seasonal high water table:* 3 to 5 feet
*Shrink-swell potential:* Low
*Potential for frost action:* Moderate

Most areas are used for cultivated crops. A few areas are used for hay and pasture or as woodland. This soil is well suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderately wide range in moisture content. Summer crops generally are not damaged by flooding.

This soil is well suited to tall fescue and switchgrass. It is moderately well suited to red clover and birdsfoot trefoil. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control increase the quantity and improve the quality of forage.

This soil is not suited to building site development or onsite waste disposal because of the flooding.

Low strength, the flooding, the shrink-swell potential, and the potential for frost action limit the use of this soil as a site for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the base with crushed rock or other suitable base material minimize the damage caused by shrinking and swelling, low strength, and flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing drainage culverts minimize the damage caused by frost action.

The land capability classification is IIw. The woodland ordination symbol is 3A, and the indicator species is white oak.

## Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 174,000 acres in the county, or about 34 percent of the total acreage, meets the soil requirements for prime farmland. Areas of prime farmland are scattered throughout the survey area, but most are in associations 1, 5, and 6 on the general soil map. The crops grown on this land mainly are soybeans, corn, winter wheat, and grain sorghum.

Some prime farmland has been lost to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units that are considered prime farmland in Macon County are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations or hazards have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations or hazards have been overcome by corrective measures. Most areas of the naturally wet soils in the county are adequately drained because of the application of drainage measures or the incidental drainage that results from farming, road building, or other kinds of land development.

# Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## Crops and Pasture

Michael J. Bradley, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Approximately 416,600 acres in Macon County, or 80 percent of the total acreage, was used for crops and pasture in 1982. Of this total, about 177,700 acres was used for permanent pasture (fig. 13) and 238,900 acres was used for cultivated crops, mainly soybeans, corn, winter wheat, and grain sorghum.

The potential of the soils in Macon County for sustained production of food is good. About 174,000 acres in the county is prime farmland. In 1982, only about 39 percent of the cropland and 80 percent of the pastureland in the survey area was adequately treated to meet conservation needs *(17)*. The cropland that was not adequately treated was likely to be on uplands, and erosion in these areas exceeds tolerable levels for sustained production. Marginal land that is used for row crops should be converted to grassland, or adequate conservation systems should be applied. Since 1982, the Conservation Reserve Program has been implemented, and in 1988, more than 35,000 acres of cropland was planted to grass *(16)*.

On most of the cropland in the county, erosion can be kept within tolerable limits by using a system of conservation practices designed for specific sites and situations. The most effective tool for predicting soil loss is the Universal Soil Loss Equation (USLE). This survey can greatly facilitate the application of such technology.

Erosion is a major problem on nearly all of the sloping cropland and overgrazed pasture in Macon County. All of the soils that have slopes of more than 2 percent are susceptible to erosion.

Loss of the surface layer through erosion is damaging for several reasons. Productivity is reduced

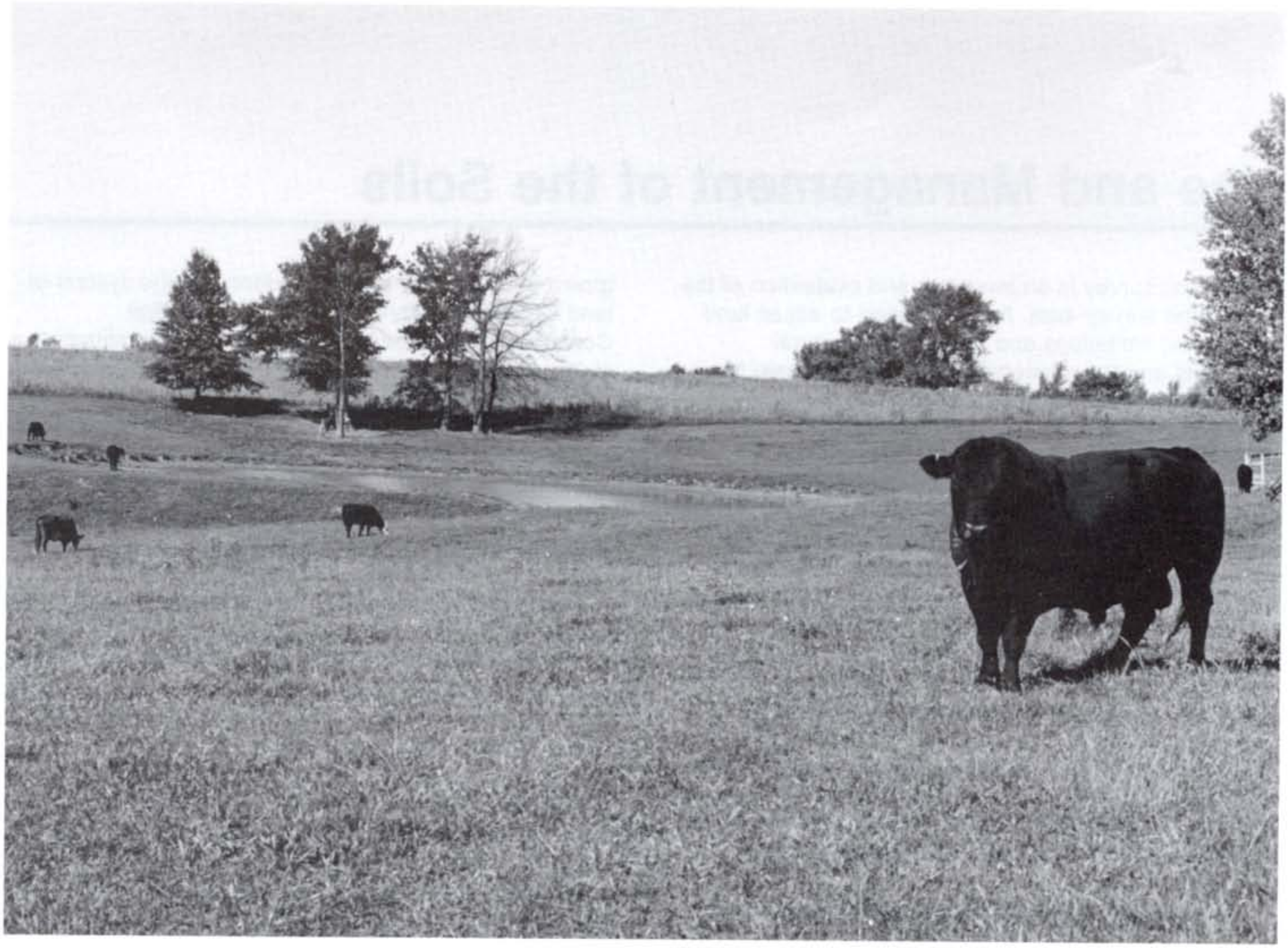

Figure 13.—Pasture in an area of Armstrong loam, 3 to 9 percent slopes, eroded.

as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil. Erosion on farmland results in the sedimentation of streams, lakes, and ponds. Erosion control minimizes this pollution and improves the quality of water for municipal and recreational uses and for fish and wildlife. It also prolongs the useful life of ponds and lakes.

Seedbed preparation and tillage are difficult in many areas of clayey soils, where erosion has resulted in the loss of the original, friable surface layer. Armstrong, Adco, Gorin, Keswick, Leonard, and Bevier soils are examples of such soils.

Erosion-control practices protect the surface layer, help to control runoff, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and preserves the productive capacity of the soil. Growing grasses and legumes for pasture and hay helps to control erosion. Including legumes, such as clover and alfalfa, in the cropping sequence improves tilth and provides nitrogen for the subsequent crop.

Terraces reduce the length of slopes and help to control runoff and erosion. Special construction and management techniques are needed if terrace systems are to be effective in most areas of the moderately sloping, eroded Keswick, Armstrong, and Leonard soils. A cropping system that provides a substantial vegetative cover is needed in addition to the terraces on these soils.

A system of conservation tillage that leaves a protective cover on the surface helps to control runoff and increases the rate of water infiltration. Conservation tillage methods include the use of tillage equipment that leaves much of the crop residue on the surface.

Contour stripcropping helps to control erosion by maintaining a permanent cover of grasses and legumes in contoured strips. The strips are generally used for hay, and the areas between the strips are used for row crops, which are planted on the contour. Contour stripcropping also can be used with alternating strips of row crops and close-growing crops, such as winter wheat.

Soil drainage and flood control are management concerns on all of the soils on flood plains in Macon County. Flooding is a hazard on Chequest, Piopolis, and Wilbur soils. The flooding, if it occurs, is commonly during the period from November through May. On soils that are naturally wet, such as Vesser and Moniteau soils, crop production may be lower than on drier soils.

Putnam soils are on broad, nearly level ridgetops in the uplands. When these very slowly permeable soils receive excess water, they stay wet for long periods. Excess water can be removed from most soils by land grading and field ditches.

Soil fertility is naturally low in most of the eroded soils, but all of the soils in the county require additional plant nutrients for maximum production. Most of the soils are naturally acid in the upper part of the root zone and require applications of ground limestone to raise the pH and the calcium level sufficiently for optimum plant growth. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the specific crop, and on the production level desired. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water. Soils that have good tilth are granular and porous. Most of the uneroded upland soils that are used for crops have a surface layer of silt loam or silty clay loam. Generally, tillage and compaction weaken the structure of soils that have a surface layer of silt loam. Periods of intensive rainfall result in the formation of a crust on the surface. The crust is hard when dry, and it reduces the rate of water infiltration and increases the runoff rate. Regularly adding crop residue, manure, and other organic material improves soil structure and tilth.

All of the eroded soils in the uplands have more clay in the surface layer, poorer tilth, a slower infiltration rate, and a more rapid runoff rate than uneroded soils. An appropriate conservation system is needed on all of the highly erodible soils to prevent further erosion.

Fall tillage is used to some extent in Macon County, but it is a poor practice on most of the soils in the uplands. These soils generally are sloping and are subject to erosion if they are plowed in the fall.

Corn and soybeans are the most commonly grown field crops and are best suited to the soils and climate of the county. From 1985 to 1988, an estimated yearly average of 80,000 acres was used for soybeans and 26,000 acres was used for corn. Grain sorghum was grown on about 4,000 acres. Winter wheat, which is the most common close-growing crop, was grown on about 16,000 acres.

The pasture and hay crops suited to the soils and climate in the county include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the most common legumes grown for hay. They also are used in mixtures that include timothy, tall fescue, bromegrass, or orchardgrass. Birdsfoot trefoil also can be used in these mixtures. Warm-season native grasses adapted to the soils in the county include big bluestem, indiangrass, and switchgrass. These grasses grow well during summer months when the cool-season species are dormant. The management techniques needed for establishment and grazing of warm-season grasses are different from those needed for cool-season grasses.

Very deep, moderately well drained soils, such as Winnegan and Purdin soils, are well suited to alfalfa. Other legumes and most grasses grow well on most of the soils in the uplands. Chequest and Piopolis soils are frequently flooded and stay wet for long periods. They are better suited to short-season summer annuals or species that can withstand wetness, such as reed canarygrass.

The major management concerns in pastured areas are overgrazing and erosion. Controlling grazing helps to keep plants at maximum production levels. Keeping grasses at a desirable height reduces the runoff rate and helps to control erosion.

A few areas in Macon County are irrigated by center-pivot or traveling-gun systems. Irrigation systems provide supplemental water during critical periods of crop growth and thus increase yields. Irrigation also makes double-cropping a feasible alternative in cropping systems. Where soybeans are planted directly into wheat stubble, an irrigation system can supply enough water to ensure germination and crop growth. Conservation tillage leaves a large amount of crop residue on the surface, which helps to protect the soil from erosion.

Specialty crops grown in the survey area include apples, peaches, pecans, Christmas trees, and various garden vegetables. The latest information on growing specialty crops can be obtained from the local office of the Cooperative Extension Service or the Soil Conservation Service.

### Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

### Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit *(19)*. Only class and subclass are used in this survey.

*Capability classes*, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

There are no class I or class VIII soils in Macon County.

*Capability subclasses* are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of water erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

## Woodland Management and Productivity

Douglas C. Wallace, forester, Soil Conservation Service, helped prepare this section.

In 1986, approximately 16 percent of Macon County was forested *(6)*. Tree species and growth rates vary, depending upon site conditions, soil types, and past management practices.

Site characteristics that affect tree growth include aspect, or the direction the slope is facing, and position on the slope. These site characteristics influence the amount of available sunlight, air drainage, soil temperature, soil moisture, and relative humidity. North- and east-facing slopes and low positions on the slope are generally the best upland sites for tree growth because they are cooler and have better moisture conditions than south- and west-facing slopes.

Soil properties are fundamentally important for woodland production. Twenty-five percent or more of the mass of a tree is in the soil, which serves as a reservoir for moisture, provides an anchor for roots, and supplies essential plant nutrients. Soil properties that affect the growth of trees include reaction, fertility, wetness, texture, structure, slope, and depth. Trees grow best on soils whose properties are not in the extreme range and that have an effective rooting depth of more than 40 inches.

Soil wetness is the result of a high water table, flooding, or ponding. It causes seedling mortality, limits the use of equipment, and increases the windthrow hazard by restricting the rooting depth of some trees. Soils that have a perched water table include the moderately well drained Keswick soils. Ruts form easily if wheeled skidders are used when the soils are wet. Deep ruts restrict lateral drainage, damage tree roots, and alter soil structure. Flooding is a hazard on some soils. On soils that are subject to flooding or ponding, equipment should be used only during dry periods or when the ground is frozen.

The slope can limit the use of forestry equipment. A slope of 15 percent or more limits the use of equipment in logging and yarding areas and on skid trails and unsurfaced logging roads. Erosion is a hazard in these disturbed areas. Special erosion-control measures, such as water bars or dips, and logging roads and skid trails that are designed to minimize the steepness and length of the slopes and to prevent the concentration of water help to control erosion. Steep slopes are a safety hazard and limit the use of equipment. Equipment should be operated on the contour where possible. Logs should be moved uphill to skid trails and yarding areas on the steeper slopes.

Woodland productivity can be influenced by management activities. Management practices can minimize the factors that reduce productivity. These practices include thinning young stands, harvesting mature trees, preventing fire, and eliminating the use of woodland for grazing. Forest fires are no longer a major problem in the county, but about 30 percent of the woodland is used for grazing. Grazing destroys the leaf layer, compacts the soil, and destroys or damages seedlings. Woodland sites that are not used for grazing and that are protected from fire have the highest potential for production.

Areas of woodland have been extensively cleared in the Armstrong-Keswick-Leonard and Winnegan-Keswick-Armstrong associations. Some areas are still wooded, primarily on steep side slopes and in narrow drainageways. Common tree species include white oak, black oak, post oak, shagbark hickory, pin oak, and black walnut. If these areas are not managed properly, low-quality species, such as shingle oak and shagbark hickory, may persist. In protected areas, isolated stands of white oak and northern red oak are on north- and east-facing slopes.

The Winnegan-Gorin-Purdin association includes the largest acreages of upland forests in the county. Common tree species include white oak, northern red oak, black oak, mockernut hickory, post oak, ash, and black walnut. The species and the growth rate vary from site to site. Stands of almost pure white oak are growing vigorously on some north- and east-facing slopes. Species that are of lower quality and that grow more slowly, such as post oak, generally are on the south-facing slopes and ridgetops. Undisturbed, forested areas of Winnegan soils are highly productive.

The Darwin-Dockery-Chequest and Piopolis-Wilbur-Moniteau associations support bottom-land hardwoods that are adapted to the poorly drained soil conditions. Most areas of these soils have been cleared for crop production. In wooded areas, typical species include green ash, pin oak, swamp white oak, sycamore, common hackberry, and river birch. Blackoar and Chequest soils may support large stands of eastern cottonwood and silver maple. The better drained minor soils support black walnut and shellbark hickory.

The soils in the Lenzburg association have been disturbed by mining activities. Forest cover on these soils is a result of plantings and natural invasion. Common species include hackberry and American elm. The forest cover helps to control erosion and provides wildlife habitat, recreational opportunities, and firewood products.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil, and *N*, snowpack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

*Erosion hazard* is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

*Equipment limitation* reflects the characteristics and conditions of the soil that restrict the use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

*Seedling mortality* refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

*Windthrow hazard* is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

*Trees to plant* are those that are suitable for commercial wood production.

## Windbreaks and Environmental Plantings

Douglas C. Wallace, forester, Soil Conservation Service, helped prepare this section.

Well designed farmstead, feedlot, and field windbreaks are needed throughout Macon County, but especially in the prairie areas of the Adco-Leonard and Darwin-Dockery-Chequest associations. Windbreaks can reduce the energy required to heat a home by 10 to 30 percent. They can temper the effects of cold winter winds and increase the comfort of people and animals *(23)*. Animals can gain a significant amount of weight over winter when they are in areas protected by windbreaks, and crop production increases when fields are protected *(15)*.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Missouri Department of Conservation, or the Cooperative Extension Service or from a commercial nursery.

## Recreation

Recreational facilities in Macon County include pools, golf courses, game courts, a skating rink, picnic areas, campgrounds, hunting areas, a shooting preserve, and lakes and ponds for fishing and recreation. The demand for recreational facilities is increasing in the survey area.

Long Branch Lake and the Thomas Hill Reservoir are the largest public recreational areas in the county. These areas offer about 13,500 acres for fishing, boating, camping, hiking, and hunting. Other recreational areas include the Atlanta State Wildlife Area, which has an area of 4,473 acres; the Hidden Hollow State Forest, 1,228 acres; the Griffith State Wildlife Area, 160 acres; and the Mussle Fork Wildlife Area, 100 acres. The Redman State Wildlife Area, which has an area of 120 acres, has a remnant population of prairie chickens. The State maintains two fishing access areas in Macon County.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and large stones on the surface. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

*Camp areas* require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

**Figure 14.—A picnic area on the shore of Macon Lake, in an area of Winnegan loam, 20 to 35 percent slopes, eroded.**

*Picnic areas* are subject to heavy foot traffic (fig. 14). Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

## Wildlife Habitat

Keith Jackson, biologist, Missouri Department of Conservation, helped prepare this section.

Macon County is one of 21 counties in Missouri that make up the Northeast Riverbreaks Zoogeographic Region *(13)*. A diversity of cover types makes this region one of the richest game areas in the state. As the transition zone between the prairie and the Ozark Border, the region is characterized by a variety and profusion of edge growth, which provides excellent wildlife habitat. The major problems affecting the wildlife resource in the county include the conversion of woodland to grassland and cropland and the loss of hedgerows and brushy areas near waterways. Also, tillage in the fall rather than in the spring decreases the amount of food available to wildlife.

More than 360 species of fish and wildlife inhabit the survey area. Some species, such as the snowy owl, are very rarely seen in the county, and many others migrate through the area in the spring and fall. Common nongame species include the red-winged blackbird, house wren, red-tailed hawk, eastern garter snake, fathead minnow, western chorus frog, and deer mouse. The most common game species include bobwhite quail, white-tailed deer, eastern wild turkey, fox squirrel, gray squirrel, eastern cottontail rabbit, largemouth bass, channel catfish, bluegill, common snapping turtle, and raccoon.

The bald eagle and Indian bat, which have been declared endangered by the Federal government, have been sighted in the county. Additionally, 18 species that have been listed as rare or endangered by the State of Missouri have been sighted. These include the wood frog, prairie chicken, Henslow's sparrow, least weasel, and western fox snake.

The furbearer population in the county is good. Raccoon, muskrat, opossum, coyote, red fox, beaver, mink, and gray fox are the principal species trapped in the survey area.

The Adco-Leonard, Darwin-Dockery-Chequest, Armstrong-Keswick-Leonard, Winnegan-Keswick-Armstrong, and Piopolis-Wilbur-Moniteau associations provide most of the habitat for openland wildlife. The Winnegan-Gorin-Purdin association also includes some acreages of hay and grass. Waterways, hedgerows, fence rows, small stands of timber, and other areas that provide woody or brushy cover are scattered throughout these associations. These areas provide an important type of habitat that is rapidly disappearing in many parts of the state used for intensive agricultural production. Common openland species include bobwhite quail, dickcissel, eastern meadowlark, and Franklin's ground squirrel.

The bobwhite quail, which is one of the most popular game species in the county, is heavily hunted. The resident dove population is poor, and fall migratory flights of this bird are minimal. Populations of ring-necked pheasants are expected to increase because of stocking by the Department of Conservation.

The Winnegan-Gorin-Purdin association provides most of the habitat for woodland wildlife. Approximately 16 percent of the county provides some form of woodland habitat, including areas that support the smaller brushy plant species *(10)*. Common woodland wildlife species include turkey, raccoon, short-tailed shrew, tufted titmouse, American toad, downy woodpecker, and white-breasted nuthatch.

The deer population in the county is good. Interest in deer hunting is very high. The turkey population is good and is expanding into additional range. Interest in turkey hunting is high. The squirrel population is good, and hunting pressure is light. Woodcock are scarce, and interest in hunting this species is low because of limited migratory flights.

Nearly all of the remaining wetland habitat in the county is in the Darwin-Dockery-Chequest and Piopolis-Wilbur-Moniteau associations, which are on bottom land. These associations, the Thomas Hill Reservoir area, Long Branch Lake, and the associated Atlanta Wildlife area are the primary waterfowl areas in the county. The reservoir areas serve as concentration points for Canada geese, snow geese, and blue geese and mallards, pintail ducks, scaup, and teal. Populations of wood ducks are low because riparian timber has been removed from the area along many streams. River otters have been stocked by the Department of Conservation.

More than 45 species of fish inhabit the waters of Macon County. Opportunities for fishing are available on rivers, streams, lakes, and farm ponds. The most important permanently flowing streams are the East and Middle Forks of the Chariton River and the Middle Fork of the Salt River. Anglers fish for channel catfish, carp, drum, bullheads, and sunfish.

Four large structures provide opportunities for impoundment fishing. These are Long Branch Lake, Thomas Hill Reservoir, Macon Lake, and La Plata City Reservoir. The largest of these, Thomas Hill Reservoir, has 2,315 surface acres in Macon County and 2,185 surface acres in Randolph County. Long Branch Lake has 2,430 surface acres. These lakes are fished for largemouth bass, channel catfish, crappie, bluegill, carp, and flathead catfish. Many farm ponds and small lakes are stocked with largemouth bass, channel catfish, and bluegill.

Wildlife habitat can be improved throughout Macon County. Practices that can improve habitat include increasing the use of conservation tillage and other soil conservation measures on cropland, preserving existing hedgerows and woody draws, planting windbreaks, including legumes and native prairie grasses for forage production, eliminating grazing of woodland, and planting marginal areas of cropland to grass-legume mixtures or to trees.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are corn, winter wheat, oats, millet, soybeans, and grain sorghum.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are bluegrass, tall fescue, switchgrass, orchardgrass, bluestem, indiangrass, clover, alfalfa, trefoil, and crownvetch.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridge pea.

*Hardwood trees* and woody understory produce nuts or other fruits, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwoods and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, cherry, apple, hawthorn, sassafras, dogwood, hickory, blackberry, wild plum, sumac, persimmon, Osageorange, and eastern redcedar. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are crabapple, wild plum, hawthorn, and hazelnut.

*Coniferous plants* furnish winter cover, browse, and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, cedar, and juniper.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wild rice, cutgrass, buttonbush, cattail, rushes, and sedges.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail, red fox, woodchuck, and mourning dove.

*Habitat for woodland wildlife* consists of areas of woody deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodchuck, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, herons, muskrat, mink, and beaver.

## Engineering

This section provides information for planning land use related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

### Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping (fig. 15). The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging,

**Figure 15.—Urban development in an area of the Adco-Leonard association. Special design helps to overcome the wetness and the shrink-swell potential of these soils.**

filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

*Dwellings* and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrinking and swelling can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. The depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), the shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

**Sanitary Facilities**

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

### Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and the shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand* and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

## Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree

**Figure 16.—Grassed waterways help to prevent the formation of rills and gullies and minimize the sedimentation of streams and lakes. These grassed waterways are in areas of Leonard silty clay loam, 2 to 6 percent slopes, eroded; Armstrong clay loam, 5 to 9 percent slopes, severely eroded; and Armstrong clay loam, 9 to 14 percent slopes, severely eroded.**

and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders. A high water table affects the amount of usable material. It also affects trafficability.

*Drainage* is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to control water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity (fig. 16). Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

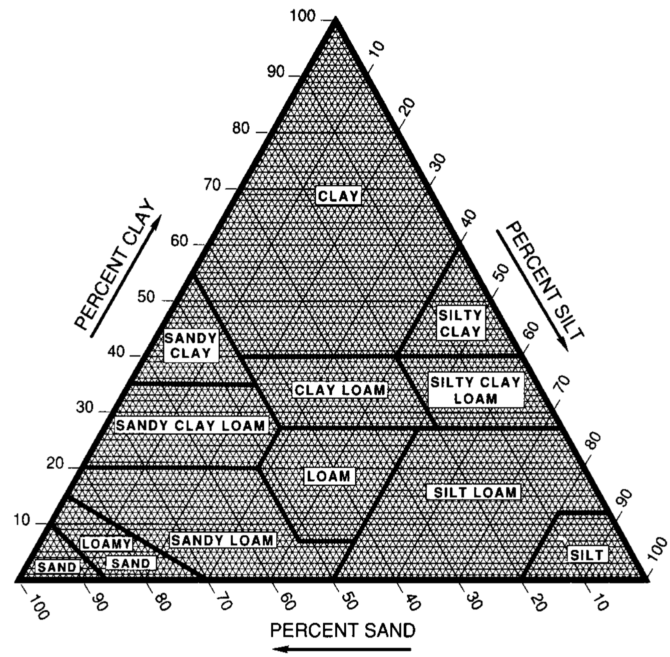


**Figure 17.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.**

## Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 17). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

*Classification* of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit* and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated content of clay in each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

The shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

# Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(20)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

## Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(21)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(20)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

### Adco Series

The Adco series consists of very deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in loess. Slopes range from 1 to 3 percent.

Typical pedon of Adco silt loam, 1 to 3 percent slopes, 500 feet south and 4,650 feet east of the northwest corner of sec. 4, T. 57 N., R. 14 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

E—8 to 12 inches; grayish brown (10YR 5/2) silty clay loam; common fine prominent yellowish red (5YR 4/6) mottles; weak thick platy structure parting to weak fine subangular blocky; friable; few very fine roots; moderately acid; abrupt smooth boundary.

Bt1—12 to 16 inches; dark gray (10YR 4/1) clay; many medium prominent strong brown (7.5YR 5/6) and common fine prominent red (2.5YR 4/6) mottles; moderate medium angular blocky structure; firm; few very fine roots; many distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—16 to 23 inches; yellowish brown (10YR 5/4) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; weak medium angular blocky structure; firm; few very fine roots; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; strongly acid; clear smooth boundary.

Btg1—23 to 31 inches; grayish brown (2.5Y 5/2) silty clay; common coarse prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few very fine roots; common distinct clay films on faces of peds; moderately acid; gradual smooth boundary.

Btg2—31 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; firm; very few very fine roots; common distinct clay films on faces of peds; moderately acid; gradual smooth boundary.

2Cg—46 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6) mottles; massive; firm; moderately acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2.

## Armstrong Series

The Armstrong series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in pedisediments and in the underlying paleosol, which formed in glacial till. Slopes range from 3 to 14 percent.

Typical pedon of Armstrong loam, 9 to 14 percent slopes, eroded, 5,030 feet east and 3,310 feet south of the northwest corner of sec. 9, T. 58 N., R. 15 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loam mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) clay from the subsoil, gray (10YR 5/1) and yellowish brown (10YR 5/4) dry; moderate fine granular structure; friable; many very fine roots; neutral; abrupt smooth boundary.

2Bt1—6 to 12 inches; dark yellowish brown (10YR 4/4) clay mixed with some streaks and pockets of very dark grayish brown (10YR 3/2) loam from the surface layer; many medium prominent red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; firm; common very fine roots; many prominent clay films on faces of peds; about 1 percent gravel; moderately acid; clear wavy boundary.

2Bt2—12 to 21 inches; brown (10YR 5/3) clay; many fine prominent yellowish red (5YR 4/6), common fine faint grayish brown (10YR 5/2), and many medium prominent yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure parting to moderate fine angular blocky; firm; common very fine roots; many prominent clay films on faces of peds; about 1 percent gravel; strongly acid; clear wavy boundary.

2Bt3—21 to 41 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate fine angular blocky; firm; few very fine roots; many prominent clay films on faces of peds; many fine concretions of manganese oxide; about 1 percent gravel; strongly acid; clear smooth boundary.

2Bk1—41 to 50 inches; clay loam with brown (10YR 4/3) ped exteriors and yellowish brown (10YR 5/6) ped interiors; many medium distinct grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure; firm; few very fine roots along prism faces; many prominent clay films on faces of peds; about 1 percent gravel; common medium stains of manganese oxide on faces of peds; many soft coarse masses of calcium; strong effervescence; slightly alkaline; gradual smooth boundary.

2Bk2—50 to 60 inches; clay loam with brown (10YR 4/3) ped exteriors and yellowish brown (10YR 5/6) ped interiors; few fine prominent light brownish gray (2.5Y 6/2) mottles; weak coarse prismatic structure; firm; few distinct clay films on vertical faces; about 1 percent gravel; common medium stains of manganese oxide on vertical faces; common fine calcium concretions; strong effervescence; slightly alkaline.

The depth to carbonates ranges from 41 to more than 60 inches.

The Ap horizon has chroma of 1 or 2. It is loam or clay loam. Some pedons have an E horizon, which has value of 4 or 5 and chroma of 2 or 3 and is loam or silt loam. The 2Bt horizon has hue of 5YR to 10YR and chroma of 2 to 6. The 2Bk horizon has hue of 10YR or 2.5Y and chroma of 3 to 6. It is clay or clay loam.

## Bevier Series

The Bevier series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess and pedisediments. Slopes range from 3 to 8 percent.

Typical pedon of Bevier silty clay loam, 3 to 8 percent slopes, eroded, 1,800 feet south and 5,100 feet east of the northwest corner of sec. 32, T. 59 N., R. 15 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many very fine roots; slightly acid; abrupt smooth boundary.

Bt1—6 to 11 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent brownish yellow (10YR 6/6) and few fine prominent strong brown (7.5YR 5/8) mottles; moderate very fine subangular blocky structure; firm; many very fine roots; common distinct clay films on faces of peds; strongly acid; abrupt smooth boundary.

Bt2—11 to 22 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; common very fine roots; many prominent clay films on faces of peds; strongly acid; clear smooth boundary.

Btg1—22 to 27 inches; grayish brown (10YR 5/2) silty clay loam; many medium prominent strong brown (7.5YR 4/6) and common fine prominent dark yellowish brown (10YR 4/6) mottles; moderate very fine angular blocky structure; firm; few very fine roots; common faint clay films on faces of peds; common fine masses of iron and manganese oxide; strongly acid; clear smooth boundary.

Btg2—27 to 34 inches; light brownish gray (2.5Y 6/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) and common medium prominent strong brown (7.5YR 4/6) mottles; weak medium and fine angular blocky structure; firm; few very fine roots; common distinct clay films on faces of peds and in root channels; few fine soft masses of iron and manganese oxide; moderately acid; abrupt smooth boundary.

2BCg—34 to 42 inches; grayish brown (10YR 5/2), yellowish brown (10YR 5/4), and brown (10YR 5/3) silt loam; weak coarse prismatic structure; firm; common very fine roots; few fine masses of iron and manganese oxide; about 20 percent sand; moderately acid; gradual smooth boundary.

2Cg—42 to 60 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) loam; massive; firm; few fine masses of iron and manganese oxide; moderately acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have an E horizon, which has hue of 10YR or 2.5Y and value of 4 or 5. Some pedons have a BE horizon, which has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is silty clay or silty clay loam. The Btg horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is silt loam or silty clay loam. The 2BCg and 2Cg horizons have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 6. They are silt loam, loam, or silty clay loam.

## Blackoar Series

The Blackoar series consists of very deep, poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Blackoar silt loam, frequently flooded, 900 feet east and 2,500 feet south of the northwest corner of sec. 11, T. 59 N., R. 14 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

A—10 to 16 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; moderately acid; clear smooth boundary.

Bg1—16 to 27 inches; gray (10YR 5/1) silt loam; common fine distinct brown (10YR 4/3) mottles; weak very fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.

Bg2—27 to 42 inches; gray (10YR 5/1) and dark gray (10YR 4/1) silt loam; many fine faint dark grayish brown (10YR 4/2) and common fine distinct dark yellowish brown (10YR 4/4) mottles; weak thin platy structure parting to moderate very fine angular blocky; friable; many very fine and fine tubular pores; few prominent organic coatings in root channels and pores; few prominent coatings of iron and manganese oxide in root channels and pores; moderately acid; gradual smooth boundary.

Cg1—42 to 53 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silt loam; common fine distinct brown and dark brown (10YR 4/3) mottles; massive; friable; many very fine tubular pores; common prominent black (10YR 2/1) organic coatings in root channels and pores; common coatings of iron and manganese oxide in root channels and pores; moderately acid; gradual smooth boundary.

Cg2—53 to 60 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay loam; common fine distinct dark yellowish brown (10YR 3/4) mottles; massive; firm; many very fine tubular pores; few prominent organic coatings in root channels and pores; few prominent coatings of iron and manganese oxide in root channels and pores; common fine concretions of iron and manganese oxide; moderately acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg and Cg horizons have hue of 10YR to 5Y.

## Bremer Series

The Bremer series consists of very deep, poorly drained, moderately slowly permeable soils on low stream terraces. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Bremer silt loam, rarely flooded, 2,800 feet east of the northwest corner of sec. 35, T. 60 N., R. 16 W.

Ap1—0 to 4 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; few very fine roots; slightly acid; abrupt smooth boundary.

Ap2—4 to 9 inches; black (10YR 2/1) silt loam, grayish brown (10YR 5/2) dry; common fine prominent dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; weak very fine granular structure; friable; few very fine roots; common very fine pores; moderately acid; abrupt smooth boundary.

A—9 to 18 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; common fine prominent dark yellowish brown (10YR 4/4) mottles; weak fine granular structure; friable; few very fine roots; common very fine pores; moderately acid; clear smooth boundary.

Btg1—18 to 28 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine prominent dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate fine angular blocky; very firm; common very fine roots; few very fine pores; many prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg2—28 to 44 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine prominent dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to strong fine angular blocky; very firm; common very fine roots; few very fine pores; many prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg3—44 to 60 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silty clay loam; few fine prominent brown (10YR 4/3) mottles; weak medium prismatic structure parting to moderate fine and medium angular blocky; very firm; common very fine roots; common very fine pores; common prominent clay films on faces of peds; slightly acid.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 to 3. The Btg horizon has hue of 10YR to 5Y. Some pedons have a Cg horizon, which has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1.

## Chariton Series

The Chariton series consists of very deep, poorly drained, slowly permeable soils on high terraces. These soils formed in loess and in the underlying alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Chariton silt loam, 1,220 feet east and 2,140 feet south of the northwest corner of sec. 10, T. 60 N., R. 16 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 5/1) dry; weak fine granular structure; very friable; many very fine roots; slightly acid; abrupt smooth boundary.

E—9 to 15 inches; grayish brown (10YR 5/2) silt loam, gray (10YR 6/1) dry; many fine faint dark grayish brown (10YR 4/2) mottles; weak medium platy structure parting to moderate very fine subangular blocky; friable; many fine roots; many fine concretions of iron and manganese oxide; strongly acid; abrupt smooth boundary.

BE—15 to 18 inches; grayish brown (10YR 5/2) silty clay loam; many fine faint dark grayish brown (10YR 4/2) and brown (10YR 4/3) and few fine prominent yellowish brown (10YR 5/6) mottles; weak very fine subangular blocky structure; friable;

many fine roots; strongly acid; abrupt smooth boundary.

Bt1—18 to 22 inches; grayish brown (10YR 5/2), dark grayish brown (10YR 4/2), and dark gray (10YR 4/1) silty clay; few fine prominent yellowish brown (10YR 5/8) mottles; strong very fine angular blocky structure; very firm; common fine roots; many distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; strongly acid; clear smooth boundary.

Bt2—22 to 37 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) and many fine faint brown (10YR 4/3) mottles; moderate very fine angular blocky structure; very firm; common fine roots; many distinct clay films on faces of peds; common fine concretions of iron and manganese oxide; moderately acid; gradual smooth boundary.

Bt3—37 to 46 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine faint grayish brown (10YR 5/2) and many fine prominent yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds and in root channels; few fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

2C—46 to 60 inches; mottled yellowish brown (10YR 5/6), gray (10YR 5/1), and strong brown (7.5YR 5/6) sandy clay loam; massive; firm; few fine roots; common dark stains; neutral.

The content of clay ranges from 48 to 60 percent in the control section.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 1 or 2. The BE horizon has value of 4 or 5 and chroma of 1 or 2. The upper part of the Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The lower part of the Bt horizon and the 2Bt horizon, if it occurs, have hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. The 2C horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 6. It is fine sandy loam, sandy clay loam, or clay loam.

## Chequest Series

The Chequest series consists of very deep, poorly drained, moderately slowly permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Chequest silty clay loam, occasionally flooded, 2,800 feet south and 4,100 feet east of the northwest corner of sec. 28, T. 58 N., R. 16 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium granular structure parting to weak fine subangular blocky; firm; common very fine roots; moderately acid; abrupt smooth boundary.

Btg1—10 to 18 inches; dark gray (10YR 4/1) silty clay loam with very dark gray (10YR 3/1) ped exteriors; few fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine granular structure; firm; common very fine roots; few faint clay films in pores; moderately acid; clear smooth boundary.

Btg2—18 to 24 inches; dark gray (10YR 4/1) silty clay loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; common very fine roots; few faint clay films on faces of peds; few fine concretions of iron and manganese oxide; moderately acid; gradual smooth boundary.

Btg3—24 to 32 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; few very fine roots; few distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; moderately acid; gradual smooth boundary.

Btg4—32 to 49 inches; dark gray (10YR 4/1) silty clay loam; many medium and coarse prominent yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine angular blocky; very firm; few very fine roots; few distinct clay films on faces of peds; few fine masses and concretions of iron and manganese oxide; moderately acid; gradual smooth boundary.

Btg5—49 to 60 inches; gray (10YR 5/1) silty clay loam; common medium prominent yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) mottles; weak coarse prismatic structure; very firm; few faint clay films on faces of peds; many prominent coatings of iron and manganese oxide on faces of peds; few fine concretions of iron and manganese oxide; moderately acid.

The Ap horizon has value of 2 or 3. The Btg horizon has hue of 10YR to 5Y and value of 4 to 6. It is silty clay or silty clay loam.

## Darwin Series

The Darwin series consists of very deep, poorly drained, very slowly permeable soils on broad flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Darwin silty clay, occasionally flooded, 1,200 feet south and 3,600 feet east of the northwest corner of sec. 4, T. 59 N., R. 16 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) and dark gray (10YR 4/1) dry; weak fine granular structure in the upper part, moderate very fine and fine angular blocky in the lower part; firm; many very fine roots; slightly acid; clear smooth boundary.

Bg1—11 to 22 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine prominent yellowish brown (10YR 5/6) mottles; weak very fine angular blocky structure; firm; common very fine roots; common pressure faces; slightly acid; clear smooth boundary.

Bg2—22 to 28 inches; dark gray (5Y 4/1) silty clay; common fine prominent light olive brown (2.5Y 5/6) mottles; weak very fine angular blocky structure; firm; few very fine roots; common prominent pressure faces; slightly acid; clear smooth boundary.

Bg3—28 to 45 inches; dark gray (5Y 4/1) silty clay; common medium prominent light olive brown (2.5Y 5/6) mottles; weak very fine angular blocky structure; firm; few very fine roots; many very fine tubular pores; common pressure faces; neutral; clear smooth boundary.

Cg—45 to 60 inches; gray (5Y 5/1) silty clay loam; common medium prominent light olive brown (2.5Y 5/6) and dark yellowish brown (10YR 4/4) mottles; massive; firm; many very fine and common fine tubular pores; neutral.

The mollic epipedon ranges from 10 to 28 inches in thickness. The content of clay ranges from 45 to 60 percent in the control section. These soils have deep, wide cracks during dry summer months.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 3 or 4 and chroma of 0 or 1. It is silty clay or clay. The Cg horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 or 1. It is silty clay or silty clay loam.

## Dockery Series

The Dockery series consists of very deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Dockery silt loam, occasionally flooded, 3,850 feet south and 3,000 feet east of the northwest corner of sec. 8, T. 57 N., R. 16 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

A—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

C1—12 to 24 inches; brown (10YR 4/3) silt loam; few fine faint grayish brown (10YR 5/2) mottles; massive; friable; few very fine roots; slightly acid; clear smooth boundary.

C2—24 to 36 inches; brown (10YR 4/3) silt loam; few fine prominent strong brown (7.5YR 4/6) and common fine and medium faint grayish brown (10YR 5/2) mottles; massive; friable; moderately acid; clear smooth boundary.

C3—36 to 42 inches; brown (10YR 4/3) loam; common medium faint dark yellowish brown (10YR 4/4) and common fine faint grayish brown (10YR 5/2) mottles; massive; friable; moderately acid; abrupt smooth boundary.

C4—42 to 60 inches; brown (10YR 4/3) loam; many fine distinct gray (10YR 5/1) and common medium faint dark brown (10YR 3/3) mottles; massive; friable; moderately acid.

The C horizon has value of 3 to 5 and chroma of 2 or 3. It is loam, silt loam, or silty clay loam.

## Excello Series

The Excello series consists of very deep, poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Excello silt loam, frequently flooded, 5,000 feet east and 200 feet south of the northwest corner of sec. 15, T. 60 N., R. 17 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak thin platy structure parting to strong fine granular; very friable; many very fine roots; few very fine tubular pores; neutral; clear smooth boundary.

A1—6 to 13 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak very fine and fine subangular blocky structure parting to moderate very fine granular; very friable; common very fine roots; few fine and common very fine tubular pores; neutral; clear smooth boundary.

A2—13 to 18 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure parting to moderate very fine granular; very friable; common very fine roots; few fine and common very fine tubular pores; neutral; clear smooth boundary.

BA—18 to 25 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine and fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

Bg1—25 to 33 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; few very fine roots; few fine and common very fine tubular pores; few faint clay films in pores and on faces of some peds; slightly acid; clear smooth boundary.

Bg2—33 to 43 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; few fine distinct dark brown (10YR 3/3) mottles; moderate medium prismatic structure parting to weak very fine subangular blocky; friable; few very fine roots; few fine and many very fine tubular pores; few faint clay films on faces of some peds; slightly acid; clear smooth boundary.

Bg3—43 to 49 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 3/4) mottles; weak medium prismatic structure; friable; few fine and common very fine tubular pores; few faint clay films on faces of some peds; slightly acid; clear smooth boundary.

BCg—49 to 60 inches; very dark gray (5Y 3/1) loam, dark gray (5Y 4/1) dry; common fine prominent dark yellowish brown (10YR 3/4) and yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; friable; few fine and many very fine tubular pores; slightly acid.

The A horizon has chroma of 1 or is neutral in hue and has chroma of 0. The BA horizon, if it occurs, is loam or silt loam. The Bg horizon has value of 2 or 3. It is loam or silt loam. The BCg horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 3 to 5 and chroma of 0 to 2. It is silt loam, silty clay loam, or clay loam. Some pedons have a Cg horizon. This horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 3 to 6 and chroma of 1 or 2. It is silt loam, silty clay loam, or clay loam.

## Floris Series

The Floris series consists of very deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Floris silt loam, occasionally flooded, 4,400 feet south and 1,820 feet east of the northwest corner of sec. 33, T. 58 N., R. 16 W.

Ap1—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; weak fine granular structure; friable; few very fine roots; slightly acid; clear smooth boundary.

Ap2—7 to 13 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; friable; few very fine roots; few medium vesicular pores; slightly acid; abrupt smooth boundary.

C1—13 to 20 inches; brown (10YR 4/3) and dark brown (10YR 3/3) silt loam; appears massive but has weak bedding planes; friable; few very fine roots; common fine tubular pores; slightly acid; clear smooth boundary.

C2—20 to 40 inches; dark brown (10YR 4/3) and brown (10YR 5/3) loam; common fine prominent strong brown (7.5YR 5/6) mottles; appears massive but has weak bedding planes; friable; very few very fine roots; few fine tubular pores; neutral; gradual smooth boundary.

C3—40 to 52 inches; brown (10YR 4/3) and dark grayish brown (10YR 4/2) loam; common fine prominent yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; appears massive but has weak bedding planes; friable; very few very fine roots; few fine tubular pores; slightly acid; gradual smooth boundary.

C4—52 to 60 inches; brown (10YR 4/3) and dark grayish brown (10YR 4/2) silt loam that has thin bands of fine sandy loam; common medium prominent yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; appears massive but has weak bedding planes; friable; few fine tubular pores; slightly acid.

The Ap horizon is loam or silt loam. The C horizon has value of 3 to 5. It is fine sandy loam or stratified loam, sandy loam, and silt loam.

## Gifford Series

The Gifford series consists of very deep, poorly drained, very slowly permeable soils on side slopes of high stream terraces. These soils formed in loess and in the underlying alluvium. Slopes range from 2 to 9 percent.

Typical pedon of Gifford silt loam, 2 to 5 percent slopes, 72 feet east and 530 feet south of the northwest corner of sec. 10, T. 60 N., R. 16 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; few fine roots; moderately acid; abrupt smooth boundary.

BE—7 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine prominent yellowish brown (10YR 5/8) mottles; weak very fine subangular blocky structure; firm; few fine roots; moderately acid; clear smooth boundary.

Btg1—10 to 14 inches; dark gray (10YR 4/1) silty clay; common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular and angular blocky structure; firm; few fine roots; few slickensides; common faint clay films on faces of peds; strongly acid; gradual smooth boundary.

Btg2—14 to 24 inches; dark gray (10YR 4/1) silty clay; many fine prominent yellowish brown (10YR 5/8) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; few fine roots; few fine dark stains and concretions of iron and manganese oxide; few slickensides; common faint clay films on faces of peds; moderately acid; gradual smooth boundary.

Btg3—24 to 30 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fine roots; few fine concretions of iron and manganese oxide; common faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Btg4—30 to 39 inches; gray (10YR 5/1) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few slickensides; few faint clay films on faces of peds; neutral; gradual smooth boundary.

2Btg5—39 to 60 inches; gray (5Y 6/1) silty clay loam; common coarse prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; about 15 percent sand; neutral.

These soils have deep, wide cracks during dry summer months.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The BE horizon has chroma of 1 or 2. The Btg horizon is silty clay or silty clay loam. The 2Btg horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2. It is silty clay, silty clay loam, or clay loam. The 2C horizon, if it occurs, has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is loam or silt loam.

The Gifford soil in map unit 44C2 has an abrupt textural change that is not definitive for the series. This difference, however, does not significantly affect the use and management of the soils.

## Gorin Series

The Gorin series consists of very deep, somewhat poorly drained, very slowly permeable soils on upland ridgetops and foot slopes. These soils formed in loess and pedisediments and in a paleosol. Slopes range from 3 to 9 percent.

Typical pedon of Gorin silt loam, 3 to 9 percent slopes, eroded, 5,180 feet south and 1,600 feet east of the northwest corner of sec. 30, T. 58 N., R. 13 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine roots; neutral; clear smooth boundary.

BE—5 to 8 inches; dark brown (10YR 4/3) silty clay loam; moderate fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—8 to 16 inches; brown (10YR 5/3) silty clay; moderate medium subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—16 to 24 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct dark grayish brown (10YR 4/2) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; very firm; common fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—24 to 33 inches; yellowish brown (10YR 5/4) silty clay loam; many coarse distinct grayish brown (10YR 5/2) and many fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak fine subangular blocky; firm; common fine roots; few distinct clay films on faces of peds; common black stains of manganese oxide on faces of peds; strongly acid; gradual smooth boundary.

2Bt4—33 to 45 inches; yellowish brown (10YR 5/4) and brown (10YR 5/3) clay loam; weak medium subangular blocky structure; firm; few fine distinct clay films on faces of peds; about 20 percent sand; few black stains of manganese oxide on faces of peds; moderately acid; gradual smooth boundary.

2Btb—45 to 60 inches; strong brown (7.5YR 5/6) clay; common medium prominent reddish brown (2.5YR 4/4) mottles; strong fine angular blocky structure; firm; common distinct clay films on faces of peds; about 2 percent fine gravel; moderately acid.

The A horizon has value of 4 or 5. The E horizon, if it occurs, and the BE horizon have value of 4 or 5. The Bt horizon is silty clay loam or silty clay. The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 4 or

5, and chroma of 3 or 4. The lower part of the Bt horizon and the 2Bt horizon have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6.

## Gosport Series

The Gosport series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in material weathered from shale and sandstone. Slopes range from 14 to 20 percent.

Typical pedon of Gosport loam, 14 to 20 percent slopes, eroded, 1,500 feet south and 800 feet east of the northwest corner of sec. 31, T. 60 N., R. 15 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; many very fine roots; very strongly acid; abrupt smooth boundary.

Bw1—6 to 12 inches; yellowish brown (10YR 5/4) loam; many fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; few faint clay films on vertical faces of peds; strongly acid; clear smooth boundary.

2Bw2—12 to 20 inches; light yellowish brown (10YR 6/4) silty clay loam; common fine prominent red (2.5YR 4/8) mottles; weak medium prismatic structure parting to strong fine angular blocky; firm; common very fine roots; many very fine tubular pores; few faint clay films on vertical peds; strongly acid; abrupt smooth boundary.

2Bw3—20 to 22 inches; brown (7.5YR 5/2) silty clay loam; common fine prominent red (2.5YR 4/8) mottles; moderate medium platy structure parting to strong medium angular blocky; very firm; common very fine roots; common very fine tubular pores; about 5 percent shale fragments; strongly acid; abrupt smooth boundary.

2Cr—22 to 60 inches; interbedded shale and sandstone.

The A horizon has value of 3 or 4 and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6.

## Keswick Series

The Keswick series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in pedisediments and in the underlying paleosol, which formed in glacial till. Slopes range from 5 to 20 percent.

Typical pedon of Keswick clay loam, 9 to 20 percent slopes, severely eroded, 1,100 feet south and 5,080 feet east of the northwest corner of sec. 11, T. 56 N., R. 13 W.

Ap—0 to 5 inches; brown (10YR 4/3) clay loam, yellowish brown (10YR 5/4) dry; moderate medium granular structure; friable; few coarse roots; very strongly acid; abrupt smooth boundary.

2Bt1—5 to 12 inches; brown (7.5YR 5/4) clay; common medium prominent yellowish red (5YR 5/6) and common fine prominent red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; about 1 percent gravel; very strongly acid; clear smooth boundary.

2Bt2—12 to 20 inches; brown (7.5YR 5/4) clay; many medium prominent light brownish gray (10YR 6/2) and common fine prominent red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; about 1 percent gravel; very strongly acid; clear smooth boundary.

2Bt3—20 to 28 inches; mixed strong brown (7.5YR 5/6) and light yellowish brown (10YR 6/4) clay; common medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; about 1 percent gravel; common soft black masses of iron and manganese oxide; moderately acid; clear smooth boundary.

2Bt4—28 to 37 inches; yellowish brown (10YR 5/4) clay loam; many medium faint yellowish brown (10YR 5/6) and common medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; few very fine roots; few distinct clay films on faces of peds; common fine stains of iron and manganese oxide on faces of peds; about 1 percent gravel; few fine concretions of iron and manganese oxide; neutral; clear smooth boundary.

2Bk—37 to 49 inches; brown (7.5YR 5/4) and strong brown (7.5YR 5/6) clay loam; common medium prominent strong brown (7.5YR 5/8) and common fine prominent light brownish gray (10YR 6/2) mottles; weak medium prismatic structure parting to weak fine and medium subangular blocky; firm; few very fine roots; few faint clay films on faces of peds; few fine stains of iron and manganese oxide on faces of peds; about 2 percent gravel; few fine concretions of iron and manganese oxide; common medium soft masses of calcium carbonate; slight effervescence; slightly alkaline; abrupt smooth boundary.

2Ck—49 to 60 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent light brownish gray (10YR 6/2) mottles; massive; very firm; about 2 percent gravel; few soft black masses of manganese oxide; many masses of calcium carbonate; many concretions of calcium carbonate; strong effervescence; slightly alkaline.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. Some pedons have an A horizon, which has value of 2 or 3 and chroma of 1 or 2 and is loam or silt loam. Some pedons have an E horizon, which has value of 4 or 5 and chroma of 2 or 3 and is loam or silt loam. The upper part of the 2Bt horizon has value of 4 or 5 and chroma of 3 to 6. The lower part has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 1 to 6. The 2Ck horizon has hue of 7.5YR to 2.5Y and chroma of 1 to 6.

## Lenzburg Series

The Lenzburg series consists of very deep, well drained, moderately slowly permeable soils. These soils formed in mine spoil, which is a mixture of partially weathered fine-earth material and fragments of bedrock. Slopes range from 9 to 70 percent.

Typical pedon of Lenzburg clay loam, 9 to 20 percent slopes, very stony, 1,150 feet south and 5,000 feet east of the northwest corner of sec. 19, T. 56 N., R. 14 W.

A—0 to 3 inches; grayish brown (10YR 5/2) clay loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many very fine roots; about 15 percent soft shale fragments; slight effervescence; slightly alkaline; abrupt smooth boundary.

C1—3 to 6 inches; dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) clay loam; weak very fine subangular blocky structure; firm; common very fine roots; about 5 percent soft shale fragments; about 10 percent sandstone fragments; neutral; abrupt broken boundary.

C2—6 to 9 inches; yellowish brown (10YR 5/4), brown (10YR 5/3), and dark grayish brown (10YR 4/2) clay loam; massive; firm; common very fine roots; about 10 percent soft shale fragments; about 10 percent sandstone fragments; slight effervescence; slightly alkaline; abrupt broken boundary.

C3—9 to 34 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/4) clay loam; massive; firm; few very fine roots; about 10 percent soft shale fragments; about 5 percent sandstone fragments; strong effervescence; slightly alkaline; abrupt broken boundary.

C4—34 to 45 inches; yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) clay loam; massive; firm; about 25 percent soft shale fragments; about 10 percent hard shale and sandstone fragments; strong effervescence; slightly alkaline; abrupt broken boundary.

C5—45 to 60 inches; dark gray (10YR 4/1) and olive yellow (2.5Y 6/8) clay loam; massive; firm; about 10 percent soft coal and shale fragments; about 10 percent hard shale and sandstone fragments; slight effervescence; slightly alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 1 to 6. The C horizon has hue of 7.5YR to 2.5Y.

## Leonard Series

The Leonard series consists of very deep, poorly drained, slowly permeable soils on uplands. These soils formed in a thin mantle of loess and in the underlying pedisediments or paleosol, which formed in glacial till. Slopes range from 2 to 6 percent.

Typical pedon of Leonard silty clay loam, 2 to 6 percent slopes, eroded, 600 feet south and 4,380 feet east of the northwest corner of sec. 21, T. 59 N., R. 14 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many very fine and fine roots; neutral; abrupt smooth boundary.

Btg1—8 to 13 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent yellowish red (5YR 4/6) and common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; many very fine roots; few distinct clay films on faces of peds; slightly acid; clear wavy boundary.

2Btg2—13 to 21 inches; dark grayish brown (10YR 4/2) silty clay; many medium prominent yellowish brown (10YR 5/6) mottles; moderate very fine angular blocky structure; firm; common very fine roots; many prominent clay films on faces of peds; about 12 percent sand; moderately acid; clear wavy boundary.

2Btg3—21 to 28 inches; grayish brown (10YR 5/2) silty clay; common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; common very fine roots; common prominent clay films on faces of peds; few fine and medium irregular masses of iron and manganese oxide; about 12 percent sand; about 1 percent gravel; few fine sand grains; moderately acid; clear wavy boundary.

2Btg4—28 to 35 inches; grayish brown (10YR 5/2) silty clay loam; few coarse prominent yellowish red (5YR 5/6) mottles; weak coarse subangular blocky structure parting to weak medium subangular blocky; firm; few very fine roots; few distinct clay films on faces of peds; few or common fine masses of iron and manganese oxide; about 13 percent sand; about 1 percent gravel; moderately acid; clear wavy boundary.

2Btg5—35 to 48 inches; grayish brown (10YR 5/2) silty clay loam; many medium prominent yellowish red (5YR 4/6) mottles; weak very fine subangular blocky structure; firm; few very fine roots; many prominent clay films on faces of peds; common fine and medium concretions of iron and manganese oxide; about 14 percent sand; about 1 percent gravel; strongly acid; gradual wavy boundary.

2Btg6—48 to 54 inches; grayish brown (10YR 5/2) silty clay loam; many fine prominent dark red (2.5YR 3/6) and many medium prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure parting to weak very fine angular blocky; firm; few very fine roots; common distinct clay films on faces of peds; common prominent coatings of iron and manganese oxide in root channels and pores; few prominent coatings of iron and manganese oxide on faces of peds; about 15 percent sand; about 1 percent gravel; strongly acid; gradual wavy boundary.

2BC—54 to 60 inches; light brownish gray (10YR 6/2) silty clay; few fine prominent red (2.5YR 4/6) and many medium prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; many prominent clay films on pressure faces; about 13 percent sand; about 1 percent gravel; strongly acid.

These soils have deep, wide cracks during dry summer months.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Btg horizon has value of 4 or 5 and chroma of 1 or 2. It is silty clay loam or silty clay. The 2Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam, silty clay, clay loam, or clay.

## Marion Series

The Marion series consists of very deep, somewhat poorly drained, very slowly permeable soils on low and high stream terraces. These soils formed in loess and alluvium. Slopes range from 1 to 3 percent.

Typical pedon of Marion silt loam, 1 to 3 percent slopes, 3,500 feet south of the northwest corner of sec. 5, T. 59 N., R. 13 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many very fine roots; moderately acid; abrupt smooth boundary.

E—9 to 15 inches; brown (10YR 5/3) silt loam; weak very fine subangular blocky structure; friable; common very fine roots; few fine concretions of iron and manganese oxide; moderately acid; abrupt smooth boundary.

EB—15 to 18 inches; brown (10YR 5/3) silt loam; weak very fine subangular blocky structure; friable; few very fine roots; common faint light brownish gray (10YR 6/2) silt coatings on faces of peds; moderately acid; abrupt smooth boundary.

Bt1—18 to 26 inches; yellowish brown (10YR 5/6) silty clay; common fine prominent grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure; firm; few very fine roots; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—26 to 36 inches; yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) silty clay; weak very fine subangular blocky structure; firm; few very fine roots; few faint clay films on faces of peds; strongly acid; abrupt smooth boundary.

BCg—36 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium and coarse prominent dark yellowish brown (10YR 4/6) mottles; weak coarse prismatic structure; firm; few slickensides and pressure faces; few coatings of iron and manganese oxide on faces of peds; moderately acid; clear smooth boundary.

2C—48 to 60 inches; grayish brown (2.5Y 5/2) silt loam; many medium prominent dark yellowish brown (10YR 4/6) mottles; massive; firm; about 22 percent sand; few coatings of iron and manganese oxide on faces of peds; moderately acid.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The E horizon has value of 5 or 6 and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 6.

## Mexico Series

The Mexico series consists of very deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in loess and in the underlying pedisediments. Slopes range from 1 to 3 percent.

Typical pedon of Mexico silt loam, 1 to 3 percent slopes, 110 feet east and 1,190 feet south of the northwest corner of sec. 23, T. 57 N., R. 13 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

E—8 to 11 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint dark yellowish brown (10YR 4/4) mottles; weak thin platy structure parting to weak fine granular; friable; few fine roots; strongly acid; clear smooth boundary.

BE—11 to 15 inches; grayish brown (10YR 5/2) silty clay loam; few fine faint reddish brown (5YR 5/4) mottles; weak medium subangular blocky structure parting to weak fine granular; firm; few fine roots; few distinct silt coatings; very strongly acid; clear smooth boundary.

Bt—15 to 26 inches; grayish brown (10YR 5/2) silty clay; many fine prominent strong brown (7.5YR 5/6) and common fine prominent red (2.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few very fine roots; common prominent clay films on faces of peds; very strongly acid; gradual smooth boundary.

Btg1—26 to 30 inches; grayish brown (10YR 5/2) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few distinct clay films on faces of peds; very strongly acid; gradual smooth boundary.

Btg2—30 to 36 inches; grayish brown (10YR 5/2) silty clay; few fine faint yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very firm; few distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

BCg—36 to 53 inches; light brownish gray (10YR 6/2) silty clay; weak medium prismatic structure; firm; strongly acid; gradual smooth boundary.

2Cg—53 to 60 inches; grayish brown (10YR 5/2) silty clay loam; few medium faint yellowish brown (10YR 5/4) mottles; massive; firm; about 15 percent sand; strongly acid.

The Ap horizon has value and chroma of 2 or 3. The Bt horizon has value of 4 or 5 and chroma of 1 or 2. It is silty clay loam, silty clay, or clay. The 2Cg horizon has value of 4 to 6 and chroma of 1 or 2. It is silty clay loam, clay loam, or silty clay.

## Moniteau Series

The Moniteau series consists of very deep, poorly drained, moderately slowly permeable soils on high flood plains. These soils formed in alluvium. Slopes range from 0 to 3 percent.

Typical pedon of Moniteau silt loam, occasionally flooded, 0 to 3 percent slopes, 2,500 feet east and 2,880 feet south of the northwest corner of sec. 35, T. 59 N., R. 13 W.

Ap—0 to 9 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) silt loam, light gray (10YR 7/2) dry; weak fine granular structure; very friable; few fine roots; slightly acid; abrupt smooth boundary.

E—9 to 22 inches; light brownish gray (10YR 6/2) silt loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak thin platy structure parting to weak fine granular; very friable; few fine roots; few black stains of manganese oxide on faces of peds; strongly acid; clear smooth boundary.

Btg1—22 to 28 inches; grayish brown (10YR 5/2) silty clay loam; few fine faint dark yellowish brown (10YR 4/4) and light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; firm; few distinct clay films in vertical root channels; very strongly acid; clear smooth boundary.

Btg2—28 to 41 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine faint brown (10YR 4/3) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; common distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg3—41 to 60 inches; dark gray (10YR 4/1) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct clay films on vertical faces of peds; few concretions of iron and manganese oxide; very strongly acid.

The Ap horizon has value of 4 or 5 and chroma of 1 or 2. The E horizon has value of 4 to 7 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y and value of 4 to 6. Some pedons have a Cg horizon, which has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. This horizon is silty clay loam or silt loam.

## Piopolis Series

The Piopolis series consists of very deep, poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Piopolis silty clay loam, frequently flooded, 2,200 feet east and 5,205 feet south of the northwest corner of sec. 9, T. 56 N., R. 13 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) and dark gray (10YR 4/1) silty clay loam, light brownish gray (10YR 6/2) dry; few fine prominent yellowish brown (10YR 5/6) and few medium faint grayish brown (10YR 5/2) mottles; moderate medium granular structure; firm; common fine roots; slightly acid; clear smooth boundary.

Cg1—9 to 21 inches; grayish brown (10YR 6/2) silty clay loam; few medium prominent dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine roots; strongly acid; abrupt smooth boundary.

Cg2—21 to 30 inches; gray (10YR 5/1) silty clay loam; common medium prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure; firm; few fine roots; few stains of iron and manganese oxide lining vertical root channels; strongly acid; abrupt smooth boundary.

Cg3—30 to 42 inches; dark gray (10YR 4/1) silty clay loam; few fine prominent strong brown (7.5YR 4/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; few fine roots; common stains of iron and manganese oxide lining root channels; strongly acid; clear smooth boundary.

Cg4—42 to 49 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; firm; common stains of iron and manganese oxide lining root channels; slightly acid; clear smooth boundary.

Cg5—49 to 60 inches; light brownish gray (10YR 6/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; few stains of iron and manganese oxide lining root channels; slightly acid.

The Ap horizon has value of 4 or 5 and chroma of 1 or 2. The Cg horizon has hue of 10YR to 5Y.

## Purdin Series

The Purdin series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 5 to 35 percent.

Typical pedon of Purdin loam, 14 to 20 percent slopes, eroded, 5,050 feet east and 4,700 feet south of the northwest corner of sec. 16, T. 59 N., R. 17 W.

Ap—0 to 5 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine granular structure; friable; many very fine roots; about 1 percent gravel; neutral; clear smooth boundary.

Bt1—5 to 10 inches; brown (10YR 4/3) clay loam; moderate fine and very fine subangular blocky structure; firm; many very fine roots; common prominent gray silt coatings; common distinct clay films on faces of peds; about 1 percent gravel; moderately acid; abrupt smooth boundary.

Bt2—10 to 21 inches; yellowish brown (10YR 5/4) clay; common fine distinct strong brown (7.5YR 5/6) mottles; weak very fine subangular blocky structure; firm; many very fine roots; many distinct clay films on faces of peds; about 1 percent gravel; few fine stains of iron and manganese oxide; moderately acid; clear smooth boundary.

Bt3—21 to 25 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure parting to weak fine angular blocky; firm; common very fine roots; common distinct clay films on faces of peds; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Bk1—25 to 32 inches; yellowish brown (10YR 5/6) clay loam; common fine faint brownish yellow (10YR 6/6) and common medium distinct brown (10YR 4/3) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; few very fine roots; common distinct clay films on vertical faces of peds; about 2 percent gravel; few fine stains of iron and manganese oxide; common fine and medium masses of calcium carbonate; strong effervescence; slightly alkaline; clear smooth boundary.

Bk2—32 to 40 inches; yellowish brown (10YR 5/4) clay loam; many medium and coarse distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; few very fine roots; few faint clay films in pores; about 2 percent gravel; common fine stains of iron and manganese oxide on faces of peds; many medium masses of calcium carbonate; strong effervescence; slightly alkaline; gradual smooth boundary.

Bk3—40 to 60 inches; yellowish brown (10YR 5/4) clay loam; many coarse prominent light brownish gray (2.5Y 6/2) mottles; weak medium prismatic structure; firm; many coarse stains of iron and manganese oxide on faces of peds; common medium masses of calcium carbonate; strong effervescence; moderately alkaline.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. Some pedons have an E horizon, which has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. This horizon is loam, silt loam, or clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 6.

## Putnam Series

The Putnam series consists of very deep, poorly drained, very slowly permeable soils on broad upland ridges. These soils formed in loess. Slopes are 0 to 1 percent.

Typical pedon of Putnam silt loam, 2,886 feet south and 1,350 feet east of the northwest corner of sec. 14, T. 57 N., R. 13 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common very fine roots; neutral; abrupt smooth boundary.

E—9 to 16 inches; grayish brown (10YR 5/2) silt loam; few fine distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; moderately acid; abrupt smooth boundary.

Btg1—16 to 22 inches; dark gray (10YR 4/1) silty clay; common fine prominent yellowish red (5YR 5/6) and strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; few very fine roots; many prominent clay films on faces of peds; strongly acid; clear wavy boundary.

Btg2—22 to 31 inches; grayish brown (10YR 5/2) silty clay; common medium prominent red (2.5YR 5/6) mottles; moderate very fine angular blocky structure; firm; few very fine roots; many prominent clay films on faces of peds; strongly acid; clear wavy boundary.

Btg3—31 to 45 inches; grayish brown (2.5Y 5/2) silty clay; many medium and coarse prominent strong brown (7.5YR 5/6) mottles; weak very fine and fine angular blocky structure; firm; few very fine roots; common distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

Btg4—45 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent dark yellowish brown (10YR 4/6) and strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; firm; common prominent clay films on faces of peds; strongly acid.

The E horizon has value of 5 or 6.

## Tice Series

The Tice series consists of very deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Tice silty clay loam, frequently flooded, 100 feet south and 4,900 feet east of the northwest corner of sec. 12, T. 60 N., R. 14 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; many very fine roots; many very fine and few fine tubular pores; slightly acid; clear smooth boundary.

A—9 to 13 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many very fine roots; common very fine and few fine tubular pores; slightly acid; clear smooth boundary.

Bw1—13 to 18 inches; dark grayish brown (10YR 4/2) silt loam; few fine prominent strong brown (7.5YR 4/6) mottles; weak very fine subangular blocky structure; friable; common very fine roots; many very fine and few fine tubular pores; moderately acid; clear smooth boundary.

Bw2—18 to 28 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint brown (10YR 4/3) mottles; weak fine subangular blocky structure; friable; common very fine roots; many very fine and few fine tubular pores; few fine concretions of iron and manganese oxide; moderately acid; clear smooth boundary.

Cg1—28 to 43 inches; grayish brown (10YR 5/2) and brown (10YR 4/3) silt loam; appears massive but has weak bedding planes; friable; few very fine roots; many very fine and few fine tubular pores; few fine concretions of iron and manganese oxide; moderately acid; gradual smooth boundary.

Cg2—43 to 60 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; appears massive but has weak bedding planes; friable; few very fine roots; common very fine and few fine tubular pores; few prominent stains of iron and manganese oxide; few fine concretions of iron and manganese oxide; moderately acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon has value of 4 or 5. It is silt loam or loam.

## Vanmeter Series

The Vanmeter series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in material weathered from calcareous shale. Slopes range from 20 to 40 percent.

Typical pedon of Vanmeter loam, 20 to 40 percent slopes, 800 feet south and 2,000 feet east of the northwest corner of sec. 18, T. 56 N., R. 13 W.

Oi—1 inch to 0; partially decomposed oak and hickory leaves and twigs; abrupt smooth boundary.

A—0 to 4 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate very fine and fine granular structure; very friable; many very fine and fine roots; slightly acid; abrupt wavy boundary.

AB—4 to 7 inches; brown (10YR 4/3) and very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; common fine prominent yellowish brown (10YR 5/6) mottles; weak very fine and fine granular structure; friable; many very fine roots; neutral; abrupt broken boundary.

Bw1—7 to 13 inches; light olive brown (2.5Y 5/4) clay; moderate very fine angular blocky structure; firm; few very fine, fine, and medium roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bw2—13 to 26 inches; light olive brown (2.5Y 5/4) and gray (5Y 5/1) clay; common fine faint light olive brown (2.5Y 5/6) mottles; moderate very fine angular blocky structure; firm; few fine roots; few faint clay films on faces of peds; about 10 percent soft rock fragments; slight effervescence; slightly alkaline; abrupt wavy boundary.

Bw3—26 to 30 inches; brownish yellow (10YR 6/6) and grayish brown (2.5Y 5/2) silty clay; weak very fine angular blocky structure; firm; slight effervescence; slightly alkaline; abrupt wavy boundary.

Cr—30 to 60 inches; olive and olive yellow shale.

The A horizon has chroma of 1 or 2. The Bw horizon has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is silty clay or clay.

## Vesser Series

The Vesser series consists of very deep, poorly drained, moderately permeable soils on high flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Vesser silt loam, occasionally flooded, 2,000 feet east and 4,600 feet south of the northwest corner of sec. 14, T. 59 N., R. 14 W.

Ap—0 to 12 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common very fine roots; common very fine tubular pores; neutral; abrupt smooth boundary.

E—12 to 24 inches; dark gray (10YR 4/1) silt loam; few fine prominent dark yellowish brown (10YR 3/4) mottles; weak medium platy structure parting to weak very fine subangular blocky; friable; few very fine roots; many very fine tubular pores; many faint silt coatings; moderately acid; abrupt smooth boundary.

Btg—24 to 34 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak very fine and fine angular blocky structure; firm; many very fine tubular pores; few distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bg—34 to 45 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct dark yellowish brown (10YR 4/4) and common faint very dark grayish brown (10YR 3/2) mottles; weak very fine angular blocky structure; firm; many very fine tubular pores; few faint clay films on faces of peds; few very dark gray (10YR 3/1) organic coatings in root channels and pores; few fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

BCg—45 to 60 inches; gray (10YR 5/1) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure; friable; many very fine tubular pores; many very dark gray (10YR 3/1) organic coatings in root channels and pores; common light gray and gray (10YR 6/1) silt coatings; slightly acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 3 to 5 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. It is clay loam or silty clay loam.

## Vigar Series

The Vigar series consists of very deep, moderately well drained, moderately slowly permeable soils on toe slopes. These soils formed in colluvium. Slopes range from 2 to 5 percent.

Typical pedon of Vigar loam, rarely flooded, 2 to 5 percent slopes, 3,300 feet south and 5,200 feet east of the northwest corner of sec. 6, T. 57 N., R. 16 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine and medium granular structure; friable; many very fine roots; neutral; clear smooth boundary.

A1—7 to 15 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine and medium granular structure; friable; many very fine roots; neutral; clear smooth boundary.

A2—15 to 20 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine and medium subangular blocky structure; friable; many very fine roots; neutral; clear smooth boundary.

BA—20 to 26 inches; very dark grayish brown (10YR 3/2) loam; weak fine subangular blocky structure; friable; many very fine roots; neutral; gradual smooth boundary.

Bt1—26 to 34 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine angular blocky structure; friable; common very fine roots; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—34 to 44 inches; dark grayish brown (10YR 4/2) and dark brown (10YR 3/3) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) and common fine faint gray (10YR 5/1) mottles; moderate fine prismatic structure parting to moderate very fine and fine angular blocky; firm; common very fine roots; common distinct clay films on faces of peds; few coatings of iron and manganese oxide on faces of peds; about 18 percent sand; slightly acid; clear smooth boundary.
2BC—44 to 60 inches; dark yellowish brown (10YR 4/4) and gray (10YR 5/1) silty clay loam; weak coarse prismatic structure; firm; few very fine roots; very few prominent clay films in root channels and pores; about 15 percent sand; about 2 percent gravel; neutral.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The BA horizon has value of 3 or 4 and chroma of 2 or 3. The Bt horizon has value of 3 to 5 and chroma of 2 to 4.

## Wilbur Series

The Wilbur series consists of very deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Wilbur silt loam, frequently flooded, 350 feet east and 3,680 feet south of the northwest corner of sec. 36, T. 58 N., R. 13 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine roots; slightly acid; clear smooth boundary.
C1—8 to 19 inches; brown (10YR 4/3) silt loam; common fine faint light brownish gray (10YR 6/2) mottles; weak fine granular structure; friable; common fine and medium roots; moderately acid; abrupt smooth boundary.
C2—19 to 36 inches; pale brown (10YR 6/3) silt loam; common medium faint grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; few very fine roots; few fine stains of iron and manganese oxide; moderately acid; abrupt smooth boundary.
C3—36 to 60 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) layers of silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; appears massive but has distinct bedding planes; friable; moderately acid.

The Ap horizon has value of 4 or 5 and chroma of 2 to 4. The C horizon has chroma of 2 to 6.

## Winnegan Series

The Winnegan series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 5 to 35 percent.

Typical pedon of Winnegan loam, 14 to 20 percent slopes, eroded, on a south-facing side slope, in a pasture, about 950 feet east and 900 feet south of the northwest corner of sec. 36, T. 57 N., R. 14 W.

Ap—0 to 3 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; many fine and very fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.
Bt1—3 to 6 inches; strong brown (7.5YR 5/6) clay loam mixed with some streaks and pockets of dark grayish brown (10YR 4/2) loam from the surface layer; moderate fine subangular blocky structure; firm; many fine roots; about 2 percent gravel; many distinct clay films on faces of peds; strongly acid; abrupt smooth boundary.
Bt2—6 to 16 inches; strong brown (7.5YR 5/6) clay; moderate fine subangular blocky structure; very firm; common fine roots; many distinct clay films on faces of peds; about 1 percent gravel; moderately acid; clear smooth boundary.
Bt3—16 to 24 inches; yellowish brown (10YR 5/6) clay loam; few medium prominent gray (10YR 6/1) mottles; moderate fine angular blocky structure; very firm; few fine roots; many distinct clay films on faces of peds; about 1 percent gravel; neutral; abrupt smooth boundary.
Btk1—24 to 29 inches; yellowish brown (10YR 5/6) clay loam; few fine prominent light brownish gray (2.5Y 6/2) mottles; strong fine prismatic structure parting to strong medium and fine angular blocky; very firm; few very fine roots; many distinct clay films on faces of peds; about 2 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.
Btk2—29 to 36 inches; brown (10YR 5/3) and yellowish brown (10YR 5/6) clay loam; few fine prominent light brownish gray (10YR 6/2) mottles; moderate fine prismatic and moderate fine angular blocky structure; very firm; few very fine roots; many distinct clay films on faces of peds; common coatings of calcium carbonate on faces of peds; about 2 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.
Btk3—36 to 49 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) clay loam; common fine prominent light brownish gray (10YR 6/2) mottles;

moderate medium prismatic structure; very firm; few very fine roots; many distinct clay films on faces of peds; about 2 percent gravel; common coatings of calcium carbonate on peds; strong effervescence; moderately alkaline; clear smooth boundary.

Bk—49 to 60 inches; light olive brown (2.5Y 5/4) clay loam; moderate coarse prismatic structure; very firm; few prominent clay films lining pores; about 2 percent gravel; common masses of calcium carbonate; strong effervescence; moderately alkaline.

Masses of calcium carbonate start at a depth of 24 to 40 inches.

The Ap horizon has value of 4 or 5 and chroma of 2 or 3. Some pedons have an A horizon, which has value and chroma of 2 or 3. Some pedons have an E horizon, which has hue of 10YR, value of 4 to 6, and chroma of 2 to 4. The A, Ap, and E horizons are loam, clay loam, or silt loam. Some pedons have a BE horizon, which has value of 4 to 6 and chroma of 3 to 6. This horizon is loam or clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. The Bk horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is clay, clay loam, or loam.

## Zook Series

The Zook series consists of very deep, poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium and colluvium. Slopes range from 1 to 5 percent.

Typical pedon of Zook silty clay loam, occasionally flooded, channeled, 1 to 5 percent slopes, 150 feet east and 3,708 feet south of the northwest corner of sec. 15, T. 59 N., R. 17 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; many very fine roots; neutral; clear smooth boundary.

A1—8 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine angular blocky structure; friable; many very fine roots; neutral; clear smooth boundary.

A2—12 to 21 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine angular blocky structure; firm; common very fine roots; few pressure faces; slightly acid; gradual smooth boundary.

A3—21 to 36 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine angular blocky structure; firm; common very fine roots; common pressure faces; neutral; gradual smooth boundary.

Bg1—36 to 50 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; moderate medium prismatic structure parting to moderate fine angular blocky; firm; few very fine roots; common pressure faces; slightly acid; gradual smooth boundary.

Bg2—50 to 60 inches; dark gray (5Y 4/1) silty clay loam, dark gray (5Y 4/1) dry; weak medium prismatic structure parting to moderate fine angular blocky; firm; few very fine roots; few pressure faces; slightly acid.

The Bg horizon has hue of 10YR to 5Y. It is silty clay or silty clay loam. Some pedons have a Cg horizon, which has hue of 10YR to 5Y and value of 2 to 4. This horizon is silty clay or silty clay loam.

# Formation of the Soils

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of a soil are determined by the type of parent material; the plant and animal life on and in the soil; the climate under which the soil-forming factors were active; relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material.

Parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Plants and animals affect the content of organic matter and the structure and porosity of the soil. Climate determines the amount of water available for leaching. It also determines the soil temperature, which causes physical changes and influences the rate of chemical changes. Climate and plant and animal life act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. Relief modifies the effects of the other factors. Finally, time is needed for the transformation of the parent material into a soil. Some time is always required for the differentiation of soil horizons, and a long time is generally required for the formation of distinct horizons.

The factors of soil formation are so closely interrelated that few generalizations can be made about the effect of any one factor unless conditions are specified for the others.

## Parent Material

Parent material is the unconsolidated mass in which a soil forms. The characteristics of this material determine the limits of the chemical and mineralogical composition of the soil. The soils in Macon County formed in residuum, or material weathered from bedrock; glacial till, or material deposited by glacial ice; loess, or material deposited by the wind; and alluvium, or material deposited by water. Some of the soils formed in more than one kind of parent material.

The residuum in Macon County consists of material weathered from limestone, shale, or sandstone. It commonly is silty clay loam or silty clay and has various amounts of soft and hard rock fragments. Gosport and Vanmeter soils formed in material weathered from shale residuum.

Glacial till is a heterogeneous mass of sand, silt, clay, and rock that was deposited over the bedrock. It ranges from about 33 to 40 percent clay. Soils that formed in this material commonly have an old, weathered surface layer. This feature is prominent in the Armstrong and Keswick soils. The till commonly is silty clay and is covered with a thin layer of sediment. The glacial till ranges from a few feet to more than 200 feet in thickness. Some soils on the lower slopes, such as Purdin and Winnegan soils, formed in glacial till but do not have an old, weathered surface layer.

Loess is silty material that probably was transported from the flood plains by the wind. It covers most of the wider ridges and ranges from a few inches to about 6 feet in thickness. Originally it was about 28 to 33 percent clay. In the areas along the Grand Divide, the loess was deposited in wide, nearly level or gently sloping divides and on ridgetops. Mexico and Putnam soils formed partly or entirely in loess in the divides and on the ridgetops. Gorin and Bevier soils formed in these deposits and in the underlying pedisediments and glacial till material.

Alluvium was deposited on nearly level flood plains along streams. Most of this material was eroded from the surrounding uplands. Chequest and Darwin soils formed in silty and clayey alluvium, and Piopolis and Wilbur soils formed in silty alluvium.

## Plants and Animals

Organic matter is an important component of the soil. Plants, insects and other animals, bacteria, and fungi furnish organic matter to the soil. Chemicals in the soil move from plant roots to the parts of the plants growing above the surface. As the plants decay, they add nutrients and organic matter to the soil. Roots help to loosen the soil. When the roots decay, channels are left for the movement of water and air.

The native vegetation of prairie grasses and trees has profoundly influenced soil formation in Macon

County. The rooting characteristics, lifespan, and mineral composition of prairie grasses differ markedly from those of deciduous trees. The micro-organisms and animals associated with each type of vegetation also differ significantly.

In forested areas, leaves, twigs, and logs slowly decompose on the surface and add organic matter to soils. The debris from forest vegetation tends to be acid. The soils that form under forest vegetation have a very thin, dark surface layer and a leached subsurface layer. In contrast, the organic matter in soils that formed under prairie grasses is largely the residue from the yearly decay of annual and biennial plants. The tops of these plants decompose on the surface, but much of the organic material is provided by the roots. This material tends to have a higher mineral content than the forest residue. Most of the vegetation in the survey area was timber or a combination of prairie and timber. The soils that formed under prairie-timber vegetation have a dark surface layer 6 to 10 inches thick and contain 3 to 6 percent organic matter. The soils that formed under forest vegetation have a dark surface layer 2 to 6 inches thick, contain 1 to 3 percent organic matter, and tend to be more acid.

Worms, insects, burrowing animals, and large animals affect soil formation. Bacteria and fungi cause the decomposition of organic material, improve tilth, and fix nitrogen in the soil. The effects of bacteria and fungi are more significant than the effects of animals. The population of organisms is directly related to the rate at which organic material decomposes in the soil. The kinds of organisms in a given area and their activity are determined by differences in vegetation.

Human activities in Macon County have greatly affected soil formation. The major effects of human activities are changes in vegetation, drainage, relief, and erosion. Prairie grasses have been replaced by cool-season grasses and row crops. Nearly all of the flood plains and many of the areas on uplands have been cleared and are farmed. Fertilizers, pesticides, and lime have been applied, wet soils have been drained, and sloping soils have been terraced. A new cycle of soil formation has begun in areas where earthmoving equipment has completely rearranged soil layers in the process of urban development. Although many of these changes have increased the production of food and fiber, the net effect of human activities in many areas of the county has been harmful in terms of sustained productivity. Accelerated erosion has reduced the potential productivity of many soils on uplands. For example, the eroded Armstrong soils have lost 4 to 6 inches of the original surface layer, and the severely eroded Armstrong soils have lost 7 to 12 inches.

## Climate

Climate has been an important factor in the formation of the soils in Macon County. Climate affects the rate of geologic erosion, which in turn affects the shape and character of landforms. The relative abundance of plants and animals and the species composition are altered by climatic change. Present climatic conditions favor the growth of trees over prairie grasses.

Macon County has a subhumid midcontinental climate. The glacial periods in the past resulted from changes in climate. During many years of cool temperatures and high precipitation, massive ice sheets formed. These ice sheets moved across a mature bedrock topography of gently undulating hills and dissected plains, which had less relief than the current Ozark topography to the south *(25)*. As warmer temperatures later caused the glacial ice to retreat, geologic erosion accelerated. Very fine sands and silt were subject to soil blowing, and loess covered the survey area.

Most extreme changes in climate occurred slowly; therefore, there were long intermediate periods when different types of vegetation grew. Soils formed and were later covered by loess, truncated, mixed by erosion, or completely eroded away. Leonard soils, for example, formed in loess and in the underlying pedisediments or paleosol, which formed in glacial till.

The higher temperatures and rainfall of the current climate result in rapid chemical changes and rapid physical disintegration. If calcium carbonates and other soluble salts are removed from the soil by leaching, the level of fertility decreases. The current climate also results in the rapid breakdown of minerals, forming clay within the soil. As the clay is moved downward, it accumulates in the subsoil. This process is known as eluviation. Nearly all of the soils on uplands show the effects of this process.

## Relief

Relief refers to the difference between the highest and lowest elevation of an area. The difference in elevation from a ridgetop to the adjacent valley floor varies, depending on the parent material and the position in the watershed.

Relief influences soil formation mainly through its effect on drainage, runoff, erosion, and exposure to sunlight and wind. The length, shape, and gradient of slopes affect soil-water relationships. The amount of water entering and passing through the soil depends on the slope, the position on the landscape, the permeability of the soil, and the amount and intensity of rainfall.

In nearly level or gently sloping areas in the uplands, runoff is slow and large amounts of water pass through the soil profile. As a result, the soils in these areas are characterized by maximum profile development. Over long periods, a subsoil that has a high content of clay forms below a leached subsurface layer. This kind of development has occurred in Putnam and Adco soils. On the steeper soils, such as Vanmeter soils, runoff is rapid and very little water passes through the profile. Consequently, distinct horizons do not develop. The results of weathering are almost immediately eliminated by geologic erosion.

## Time

Time allows climate, living organisms, and relief to affect the parent material. The degree to which the material is altered determines the age of a soil. Thus, the age is inferred from the morphology of the soil.

The most fertile and productive soils in the county formed in recent alluvium, which contains organic matter and mineral-rich soil material from the dark surface layer of upland soils. Darwin, Dockery, Tice, and Wilbur soils are examples. These soils are young.

Soils on terraces are intermediate in age between the soils on flood plains and those on uplands. Moniteau and Vesser soils, for example, show a degree of maturity indicated by a reduced level of fertility and by the formation of argillic horizons. However, these soils also have stratification in the lower part of the substratum, which is characteristic of soils that formed in recent alluvium on flood plains.

Soils on uplands generally are mature. They are characterized by a reduced level of fertility and a strongly expressed argillic horizon. They tend to be on the older landforms. Nearly level to gently sloping soils at the highest elevations are the oldest soils in the county. They are characterized by the maximum development of distinct horizons. Adco, Mexico, and Putnam soils are examples. The carbonates that originally were in the parent material have been leached to a great depth, leaving the soils quite acid throughout. A highly bleached subsurface horizon is formed as weatherable material is leached out of it, and clay has been formed by weathering and has been translocated by water to form a distinct subsoil.

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# Glossary

**ABC soil.** A soil having an A, a B, and a C horizon.

**AC soil.** A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

| | |
|---|---|
| Very low | 0 to 3 |
| Low | 3 to 6 |
| Moderate | 6 to 9 |
| High | 9 to 12 |
| Very high | more than 12 |

**Base saturation.** The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

**Bedding planes.** Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Capillary water.** Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

**Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

**Cation-exchange capacity.** The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

**Chiseling.** Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

**Coarse textured soil.** Sand or loamy sand.

**Colluvium.** Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping.** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are altered with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Deferred grazing.** Postponing grazing or resting grazing land for a prescribed period.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Eluviation.** The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

**Fine textured soil.** Sandy clay, silty clay, or clay.

**First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Frost action** (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Glacial drift** (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

**Glacial till** (geology). Unsorted nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

**Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

**Green manure crop** (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

**Ground water** (geology). Water filling all the unblocked pores of the material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Head slope.** The concave surface at the head of a drainageway where the flow of water converges downward toward the center and contour lines form concave curves.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon.*—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

*Cr horizon.*—Soft, consolidated bedrock beneath the soil.

*R layer.*—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

**Humus.** The well decomposed, more or less stable part of the organic matter in mineral soils.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly very deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration capacity.** The maximum rate at which water can infiltrate into a soil under a given set of conditions.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

| | |
|---|---|
| Less than 0.2 | very low |
| 0.2 to 0.4 | low |
| 0.4 to 0.75 | moderately low |
| 0.75 to 1.25 | moderate |
| 1.25 to 1.75 | moderately high |
| 1.75 to 2.5 | high |
| More than 2.5 | very high |

**Interfluve.** A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to these drainageways.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are:

*Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Drip (or trickle).*—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

*Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler.*—Water is sprayed over the surface through pipes or nozzles from a pressure system.

*Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Landform.** Any recognizable physical feature of the earth's surface that has a characteristic shape and is produced by natural causes. It includes mountains, plateaus, plains, valleys, flood plains, terraces, and others. The landforms make up the surface configuration of the earth.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by the wind.

**Low strength.** The soil is not strong enough to support loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

**Mine spoil.** Unconsolidated material that has been moved, mixed, and redeposited during mining activities.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

**Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nose slope.** The projecting end of an interfluve, where contour lines connecting the opposing side slopes form convex curves around the projecting end and lines perpendicular to the contours diverge downward. Overland flow of water is divergent.

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percs slowly** (in tables). The slow movement of water through the soil, adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

| | |
|---|---|
| Very slow | less than 0.06 inch |
| Slow | 0.06 to 0.2 inch |
| Moderately slow | 0.2 to 0.6 inch |
| Moderate | 0.6 inch to 2.0 inches |
| Moderately rapid | 2.0 to 6.0 inches |
| Rapid | 6.0 to 20 inches |
| Very rapid | more than 20 inches |

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range in moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Ponding.** Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poorly graded.** Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

| | |
|---|---|
| Extremely acid | below 4.5 |
| Very strongly acid | 4.5 to 5.0 |
| Strongly acid | 5.1 to 5.5 |
| Moderately acid | 5.6 to 6.0 |
| Slightly acid | 6.1 to 6.5 |
| Neutral | 6.6 to 7.3 |
| Slightly alkaline | 7.4 to 7.8 |
| Moderately alkaline | 7.9 to 8.4 |
| Strongly alkaline | 8.5 to 9.0 |
| Very strongly alkaline | 9.1 and higher |

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

**Ridge.** A long, narrow elevation of the land surface, usually sharp crested with steep sides forming an extended upland between valleys.

**Rill.** A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

**Rippable.** Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-sized particles.

**Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Shoulder.** The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It is the transition zone from back slope to summit of an upland. The surface is dominantly convex in profile and erosional in origin.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Side slope.** The slope bounding a drainageway and lying between the drainageway and the adjacent interfluve. It generally is linear along the slope width. Overland flow is parallel down the slope.

**Silica.** A combination of silicon and oxygen. The mineral form is called quartz.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Siltstone.** Sedimentary rock made up of dominantly silt-sized particles.

**Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

**Site index.** A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

| | |
|---|---|
| Nearly level | 0 to 2 percent |
| Very gently sloping | 1 to 3 percent |
| Gently sloping | 2 to 5 percent |
| Moderately sloping | 5 to 9 percent |
| Strongly sloping | 9 to 14 percent |
| Moderately steep | 14 to 20 percent |
| Steep | 20 to 35 percent |
| Very steep | more than 35 percent |

**Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

**Slow intake** (in tables). The slow movement of water into the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

| | |
|---|---|
| Very coarse sand | 2.0 to 1.0 |
| Coarse sand | 1.0 to 0.5 |
| Medium sand | 0.5 to 0.25 |
| Fine sand | 0.25 to 0.10 |
| Very fine sand | 0.10 to 0.05 |
| Silt | 0.05 to 0.002 |
| Clay | less than 0.002 |

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

**Stone line.** A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediments of variable thickness.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Stubble mulch.** Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Subsoiling.** Breaking up a compact subsoil by pulling a special chisel through the soil.

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Any surface soil horizon (A, E, AB, or EB) below the surface layer.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil.** The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer** (in tables). Otherwise suitable soil material that is too thin for the specified use.

**Till plain.** An extensive area of nearly level to undulating soils underlain by glacial till.

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Toe slope.** The outermost inclined surface at the base of a hill; part of a foot slope.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Valley fill.** In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

**Variegation.** Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

**Water break (or water bar).** A hump or small surface drainage structure that is shaped like a dike. It is used only on closed roads, fire lines, or abandoned skid trails.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

# Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-84 at Macon, Missouri)

| Month | Temperature | | | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 years in 10 will have-- | | | | 2 years in 10 will have-- | | | |
| | Average daily maximum | Average daily minimum | Average daily | Maximum temperature higher than-- | Minimum temperature lower than-- | Average number of growing degree days* | Average | Less than-- | More than-- | Average number of days with 0.10 inch or more | Average snowfall |
| | °F | °F | °F | °F | °F | Units | In | In | In | | In |
| January----- | 33.5 | 13.9 | 23.7 | 63 | 11 | 0 | 1.36 | 0.40 | 2.12 | 3 | 6.5 |
| February---- | 39.7 | 19.1 | 29.4 | 68 | 11 | 8 | 1.39 | .66 | 2.01 | 4 | 6.2 |
| March------- | 49.8 | 28.3 | 39.1 | 82 | 4 | 41 | 2.97 | 1.50 | 4.25 | 6 | 5.2 |
| April------- | 64.3 | 41.5 | 52.9 | 87 | 21 | 159 | 3.97 | 2.02 | 5.65 | 7 | .5 |
| May--------- | 74.5 | 51.8 | 63.2 | 90 | 32 | 417 | 4.89 | 3.07 | 6.52 | 8 | .0 |
| June-------- | 83.2 | 61.0 | 72.1 | 95 | 46 | 663 | 4.88 | 2.55 | 6.91 | 7 | .0 |
| July-------- | 88.5 | 65.6 | 77.1 | 101 | 51 | 840 | 4.51 | 1.56 | 6.94 | 6 | .0 |
| August------ | 86.9 | 63.1 | 75.0 | 100 | 49 | 776 | 3.87 | 1.92 | 5.55 | 5 | .0 |
| September--- | 79.2 | 54.6 | 66.9 | 96 | 36 | 507 | 4.17 | 1.50 | 6.39 | 6 | .0 |
| October----- | 68.0 | 43.3 | 55.7 | 89 | 24 | 216 | 3.47 | 1.41 | 5.23 | 6 | .0 |
| November---- | 52.2 | 31.1 | 41.7 | 77 | 8 | 23 | 2.21 | .66 | 3.46 | 4 | 1.1 |
| December---- | 38.6 | 20.3 | 29.5 | 66 | 8 | 7 | 1.85 | .85 | 2.70 | 4 | 4.7 |
| Yearly: | | | | | | | | | | | |
| Average--- | 63.2 | 41.1 | 52.2 | --- | --- | --- | --- | --- | --- | --- | --- |
| Extreme--- | --- | --- | --- | 102 | 8 | --- | --- | --- | --- | --- | --- |
| Total----- | --- | --- | --- | --- | --- | 3,656 | 39.54 | 31.43 | 46.86 | 66 | 24.2 |

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-84 at Macon, Missouri)

| Probability | Temperature | | |
|---|---|---|---|
| | 24 °F or lower | 28 °F or lower | 32 °F or lower |
| Last freezing temperature in spring: | | | |
| 1 year in 10 later than-- | Apr. 15 | Apr. 24 | May 1 |
| 2 years in 10 later than-- | Apr. 10 | Apr. 19 | Apr. 27 |
| 5 years in 10 later than-- | Apr. 1 | Apr. 10 | Apr. 19 |
| First freezing temperature in fall: | | | |
| 1 year in 10 earlier than-- | Oct. 25 | Oct. 14 | Oct. 7 |
| 2 years in 10 earlier than-- | Oct. 29 | Oct. 20 | Oct. 11 |
| 5 years in 10 earlier than-- | Nov. 7 | Oct. 30 | Oct. 20 |

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-84 at Macon, Missouri)

| Probability | Daily minimum temperature during growing season | | |
|---|---|---|---|
| | Higher than 24 °F | Higher than 28 °F | Higher than 32 °F |
| | Days | Days | Days |
| 9 years in 10 | 197 | 182 | 167 |
| 8 years in 10 | 204 | 188 | 172 |
| 5 years in 10 | 219 | 202 | 183 |
| 2 years in 10 | 233 | 215 | 194 |
| 1 year in 10 | 240 | 222 | 200 |

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

| Map symbol | Soil name | Acres | Percent |
|---|---|---|---|
| 14C2 | Armstrong loam, 3 to 9 percent slopes, eroded | 31,470 | 6.1 |
| 14D2 | Armstrong loam, 9 to 14 percent slopes, eroded | 26,865 | 5.2 |
| 15C3 | Armstrong clay loam, 5 to 9 percent slopes, severely eroded | 9,125 | 1.8 |
| 15D3 | Armstrong clay loam, 9 to 14 percent slopes, severely eroded | 18,895 | 3.6 |
| 16C2 | Bevier silty clay loam, 3 to 8 percent slopes, eroded | 12,075 | 2.3 |
| 17C | Purdin loam, 5 to 9 percent slopes | 1,250 | 0.2 |
| 17E | Purdin loam, 14 to 20 percent slopes | 4,430 | 0.9 |
| 17E2 | Purdin loam, 14 to 20 percent slopes, eroded | 20,975 | 4.0 |
| 17F | Purdin loam, 20 to 35 percent slopes | 3,045 | 0.6 |
| 17F2 | Purdin clay loam, 20 to 35 percent slopes, eroded | 8,870 | 1.7 |
| 18C2 | Gorin silt loam, 3 to 9 percent slopes, eroded | 22,015 | 4.2 |
| 19E2 | Gosport loam, 14 to 20 percent slopes, eroded | 3,450 | 0.7 |
| 22F | Vanmeter loam, 20 to 40 percent slopes | 3,440 | 0.7 |
| 23C2 | Keswick clay loam, 5 to 9 percent slopes, eroded | 23,060 | 4.4 |
| 23E3 | Keswick clay loam, 9 to 20 percent slopes, severely eroded | 54,775 | 10.5 |
| 26B2 | Leonard silty clay loam, 2 to 6 percent slopes, eroded | 29,955 | 5.8 |
| 27C | Winnegan loam, 5 to 9 percent slopes | 2,400 | 0.5 |
| 27E2 | Winnegan loam, 14 to 20 percent slopes, eroded | 32,255 | 6.2 |
| 27F | Winnegan loam, 20 to 35 percent slopes | 28,715 | 5.5 |
| 27F2 | Winnegan loam, 20 to 35 percent slopes, eroded | 6,640 | 1.3 |
| 30B | Mexico silt loam, 1 to 3 percent slopes | 6,540 | 1.3 |
| 31 | Putnam silt loam | 4,220 | 0.8 |
| 32B | Adco silt loam, 1 to 3 percent slopes | 23,555 | 4.5 |
| 32B2 | Adco silt loam, 1 to 3 percent slopes, eroded | 10,945 | 2.1 |
| 40 | Vesser silt loam, occasionally flooded | 5,450 | 1.0 |
| 41B | Marion silt loam, 1 to 3 percent slopes | 1,845 | 0.4 |
| 42 | Bremer silt loam, rarely flooded | 3,510 | 0.7 |
| 43 | Chariton silt loam | 1,255 | 0.2 |
| 44B | Gifford silt loam, 2 to 5 percent slopes | 2,710 | 0.5 |
| 44C2 | Gifford silt loam, 5 to 9 percent slopes, eroded | 5,155 | 1.0 |
| 45A | Moniteau silt loam, occasionally flooded, 0 to 3 percent slopes | 7,890 | 1.5 |
| 46B | Vigar loam, rarely flooded, 2 to 5 percent slopes | 1,755 | 0.3 |
| 51 | Wilbur silt loam, frequently flooded | 13,315 | 2.6 |
| 52 | Blackoar silt loam, frequently flooded | 5,830 | 1.1 |
| 53 | Chequest silty clay loam, occasionally flooded | 9,830 | 1.9 |
| 55 | Piopolis silty clay loam, frequently flooded | 8,080 | 1.6 |
| 56 | Darwin silty clay, occasionally flooded | 12,415 | 2.4 |
| 57 | Floris loam, frequently flooded | 4,525 | 0.9 |
| 58 | Excello silt loam, frequently flooded | 2,825 | 0.5 |
| 60E | Lenzburg clay loam, 9 to 20 percent slopes, very stony | 2,185 | 0.4 |
| 60F | Lenzburg clay loam, 35 to 70 percent slopes, very stony | 4,940 | 0.9 |
| 63B | Zook silty clay loam, occasionally flooded, channeled, 1 to 5 percent slopes | 7,040 | 1.4 |
| 65 | Dockery silt loam, occasionally flooded | 7,090 | 1.4 |
| 66 | Tice silty clay loam, frequently flooded | 7,950 | 1.5 |
| 67 | Aquents, frequently flooded | 2,610 | 0.5 |
| 68 | Bremer loam, occasionally flooded, overwash | 1,275 | 0.2 |
| 69 | Floris silt loam, occasionally flooded | 1,225 | 0.2 |
| | Water areas more than 40 acres in size | 10,356 | 2.0 |
| | Total | 520,026 | 100.0 |

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

| Map symbol | Soil name |
|---|---|
| 26B2 | Leonard silty clay loam, 2 to 6 percent slopes, eroded (where drained) |
| 30B | Mexico silt loam, 1 to 3 percent slopes (where drained) |
| 31 | Putnam silt loam (where drained) |
| 32B | Adco silt loam, 1 to 3 percent slopes |
| 32B2 | Adco silt loam, 1 to 3 percent slopes, eroded |
| 40 | Vesser silt loam, occasionally flooded (where drained) |
| 41B | Marion silt loam, 1 to 3 percent slopes |
| 42 | Bremer silt loam, rarely flooded (where drained) |
| 43 | Chariton silt loam (where drained) |
| 44B | Gifford silt loam, 2 to 5 percent slopes (where drained) |
| 45A | Moniteau silt loam, occasionally flooded, 0 to 3 percent slopes (where drained) |
| 46B | Vigar loam, rarely flooded, 2 to 5 percent slopes |
| 51 | Wilbur silt loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season) |
| 52 | Blackoar silt loam, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season) |
| 53 | Chequest silty clay loam, occasionally flooded (where drained and either protected from flooding or not frequently flooded during the growing season) |
| 55 | Piopolis silty clay loam, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season) |
| 56 | Darwin silty clay, occasionally flooded (where drained) |
| 57 | Floris loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season) |
| 58 | Excello silt loam, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season) |
| 65 | Dockery silt loam, occasionally flooded |
| 66 | Tice silty clay loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season) |
| 68 | Bremer loam, occasionally flooded, overwash (where drained) |
| 69 | Floris silt loam, occasionally flooded |

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

| Soil name and map symbol | Land capability | Corn | Soybeans | Grain sorghum | Winter wheat | Orchard-grass-red clover hay | Tall fescue | Switchgrass |
|---|---|---|---|---|---|---|---|---|
| | | Bu | Bu | Bu | Bu | Tons | AUM* | AUM* |
| 14C2------------ Armstrong | IIIe | 93 | 31 | 73 | 37 | 3.1 | 4.7 | 6.2 |
| 14D2------------ Armstrong | IVe | 80 | 29 | 64 | 32 | 2.7 | 4.0 | 5.4 |
| 15C3------------ Armstrong | IVe | 86 | 31 | 69 | 34 | 2.9 | 4.3 | 5.8 |
| 15D3------------ Armstrong | VIe | --- | --- | --- | --- | 2.5 | 2.3 | 5.0 |
| 16C2------------ Bevier | IIIe | 95 | 32 | 78 | 40 | 3.3 | 5.0 | 6.6 |
| 17C------------- Purdin | IIIe | 103 | 34 | 83 | 41 | 3.8 | 5.3 | 7.0 |
| 17E------------- Purdin | VIe | --- | --- | --- | --- | 3.0 | 4.1 | 5.5 |
| 17E2------------ Purdin | VIe | --- | --- | --- | --- | 2.8 | 3.8 | 5.1 |
| 17F, 17F2------- Purdin | VIe | --- | --- | --- | --- | --- | 2.9 | 4.5 |
| 18C2------------ Gorin | IIIe | 86 | 29 | 68 | 34 | 2.9 | 4.3 | 5.8 |
| 19E2------------ Gosport | VIe | --- | --- | --- | --- | 1.9 | 2.9 | 3.8 |
| 22F------------- Vanmeter | VIIe | --- | --- | --- | --- | --- | 1.9 | 2.0 |
| 23C2------------ Keswick | IIIe | 92 | 30 | 73 | 37 | 3.1 | 4.7 | 6.2 |
| 23E3------------ Keswick | VIe | --- | --- | --- | --- | 2.0 | 3.0 | 4.0 |
| 26B2------------ Leonard | IIIe | 90 | 30 | 71 | 33 | 3.1 | 4.5 | 6.0 |
| 27C------------- Winnegan | IIIe | 90 | 30 | 72 | 38 | 3.1 | 4.5 | 6.0 |
| 27E2------------ Winnegan | VIe | --- | --- | --- | --- | 2.3 | 3.5 | 4.6 |
| 27F, 27F2------- Winnegan | VIe | --- | --- | --- | --- | --- | 3.3 | 4.4 |
| 30B------------- Mexico | IIe | 107 | 35 | 84 | 43 | 3.6 | 5.4 | 7.2 |

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

| Soil name and map symbol | Land capability | Corn | Soybeans | Grain sorghum | Winter wheat | Orchard-grass-red clover hay | Tall fescue | Switchgrass |
|---|---|---|---|---|---|---|---|---|
| | | Bu | Bu | Bu | Bu | Tons | AUM* | AUM* |
| 31---------------<br>Putnam | IIw | 105 | 34 | 84 | 43 | 3.6 | 5.4 | 7.2 |
| 32B-------------<br>Adco | IIe | 107 | 35 | 84 | 43 | 3.5 | 5.3 | 7.0 |
| 32B2------------<br>Adco | IIIe | 95 | 31 | 72 | 37 | 3.3 | 4.3 | 6.2 |
| 40---------------<br>Vesser | IIw | 120 | 40 | 94 | 48 | 4.0 | 6.0 | 8.0 |
| 41B-------------<br>Marion | IIIe | 85 | 32 | 75 | 34 | 3.2 | 4.8 | 6.4 |
| 42---------------<br>Bremer | IIw | 126 | 42 | 98 | 50 | 4.2 | 5.9 | 8.4 |
| 43---------------<br>Chariton | IIw | 103 | 36 | 85 | 43 | 3.5 | 5.3 | 7.0 |
| 44B-------------<br>Gifford | IIe | 95 | 31 | 75 | 39 | 3.1 | 4.7 | 6.2 |
| 44C2------------<br>Gifford | IIIe | 80 | 29 | 63 | 33 | 2.6 | 3.9 | 5.2 |
| 45A-------------<br>Moniteau | IIIw | 100 | 33 | 80 | 41 | 3.4 | 5.1 | 6.8 |
| 46B-------------<br>Vigar | IIe | 127 | 44 | 101 | 52 | 4.3 | 6.5 | 8.6 |
| 51---------------<br>Wilbur | IIw | 100 | 33 | 80 | 41 | 3.4 | 6.5 | 6.8 |
| 52---------------<br>Blackoar | IIIw | 103 | 42 | 98 | 50 | 4.2 | 5.9 | 8.4 |
| 53---------------<br>Chequest | IIIw | 105 | 34 | 84 | 43 | 3.6 | 5.4 | 7.2 |
| 55---------------<br>Piopolis | IIIw | 100 | 33 | 80 | 41 | 3.4 | 5.1 | 6.8 |
| 56---------------<br>Darwin | IIIw | 105 | 35 | 84 | 43 | 3.6 | 5.4 | 7.2 |
| 57---------------<br>Floris | IIIw | 73 | 24 | 59 | 30 | 2.4 | 3.6 | 4.8 |
| 58---------------<br>Excello | IIIw | 107 | 36 | 84 | 43 | 3.6 | 5.5 | 7.2 |
| 60E-------------<br>Lenzburg | VIe | --- | --- | --- | --- | 1.5 | 2.3 | 3.0 |
| 60F-------------<br>Lenzburg | VIIe | --- | --- | --- | --- | --- | --- | --- |

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

| Soil name and map symbol | Land capability | Corn | Soybeans | Grain sorghum | Winter wheat | Orchard-grass-red clover hay | Tall fescue | Switchgrass |
|---|---|---|---|---|---|---|---|---|
| | | Bu | Bu | Bu | Bu | Tons | AUM* | AUM* |
| 63B-------------<br>Zook | IIIw | 107 | 35 | 84 | 43 | 3.6 | 5.4 | 7.2 |
| 65--------------<br>Dockery | IIw | 128 | 37 | 100 | 53 | 4.5 | 6.6 | 8.8 |
| 66--------------<br>Tice | IIIw | 118 | 40 | 92 | 46 | 3.9 | 5.9 | 7.8 |
| 67--------------<br>Aquents | VIIw | --- | --- | --- | --- | --- | --- | --- |
| 68--------------<br>Bremer | IIw | 130 | 47 | 100 | 50 | 4.2 | 5.9 | 8.4 |
| 69--------------<br>Floris | IIw | 90 | 32 | 71 | 36 | 3.0 | 4.5 | 6.0 |

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

| Soil name and map symbol | Ordination symbol | Management concerns: Erosion hazard | Management concerns: Equipment limitation | Management concerns: Seedling mortality | Management concerns: Windthrow hazard | Potential productivity: Common trees | Potential productivity: Site index | Potential productivity: Volume* | Trees to plant |
|---|---|---|---|---|---|---|---|---|---|
| 14C2, 14D2, 15C3, 15D3 Armstrong | 3C | Slight | Slight | Moderate | Slight | White oak | 55 | 38 | Eastern white pine, red pine. |
| | | | | | | Black oak | 65 | 48 | |
| 16C2 Bevier | 3C | Slight | Slight | Severe | Slight | White oak | 55 | 38 | White oak, eastern white pine. |
| 17C Purdin | 3A | Slight | Slight | Slight | Slight | White oak | 60 | 43 | White oak, white ash, black oak, northern red oak. |
| | | | | | | Post oak | --- | --- | |
| | | | | | | Black oak | --- | --- | |
| | | | | | | Shagbark hickory | --- | --- | |
| 17E, 17E2, 17F, 17F2 Purdin | 3R | Moderate | Moderate | Slight | Slight | White oak | 60 | 43 | White oak, white ash, black oak, northern red oak. |
| | | | | | | Post oak | --- | --- | |
| | | | | | | Black oak | --- | --- | |
| | | | | | | Shagbark hickory | --- | --- | |
| 18C2 Gorin | 3C | Slight | Slight | Moderate | Severe | White oak | 53 | 36 | White oak, white ash, pin oak, black oak. |
| | | | | | | Black oak | 61 | 44 | |
| | | | | | | Northern red oak | 62 | 45 | |
| 19E2 Gosport | 2R | Moderate | Moderate | Severe | Moderate | White oak | 54 | 38 | Eastern white pine, red pine, black oak. |
| | | | | | | Post oak | --- | --- | |
| 22F Vanmeter | 2R | Severe | Severe | Severe | Moderate | White oak | 49 | 33 | Eastern white pine, red pine, eastern redcedar, black oak. |
| 23C2 Keswick | 3C | Slight | Slight | Moderate | Slight | White oak | 57 | 40 | Eastern white pine, red pine, black oak. |
| | | | | | | Black oak | 62 | 45 | |
| | | | | | | Post oak | 54 | 38 | |
| 23E3 Keswick | 3R | Moderate | Moderate | Moderate | Slight | White oak | 57 | 40 | Eastern white pine, red pine, black oak. |
| | | | | | | Black oak | 62 | 45 | |
| | | | | | | Post oak | 54 | 38 | |
| 27C Winnegan | 3A | Slight | Slight | Slight | Slight | White oak | 57 | 40 | White oak, black oak, white ash, northern red oak. |
| | | | | | | Northern red oak | --- | -- | |

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| Soil name and map symbol | Ordination symbol | Management concerns: Erosion hazard | Management concerns: Equipment limitation | Management concerns: Seedling mortality | Management concerns: Windthrow hazard | Potential productivity: Common trees | Potential productivity: Site index | Potential productivity: Volume* | Trees to plant |
|---|---|---|---|---|---|---|---|---|---|
| 27E2, 27F, 27F2-- Winnegan | 3R | Moderate | Moderate | Slight | Slight | White oak<br>Northern red oak | 60<br>--- | 43<br>--- | White oak, black oak, white ash, northern red oak. |
| 41B-- Marion | 2W | Slight | Severe | Moderate | Severe | White oak<br>Post oak<br>Black oak | 50<br>47<br>57 | 34<br>32<br>40 | White oak, pin oak, green ash, yellow-poplar, eastern cottonwood, silver maple, black willow. |
| 42-- Bremer | 7W | Slight | Severe | Moderate | Moderate | Eastern cottonwood<br>Silver maple | 90<br>80 | 103<br>50 | Silver maple, eastern cottonwood, American sycamore, hackberry, green ash, northern whitecedar. |
| 45A-- Moniteau | 4W | Slight | Severe | Moderate | Moderate | Pin oak | 70 | 52 | White oak, pin oak, green ash, eastern cottonwood, silver maple, black willow, sweetgum, willow oak. |
| 51-- Wilbur | 4A | Slight | Slight | Slight | Slight | Green ash<br>American sycamore<br>Eastern cottonwood | 90<br>87<br>94 | 65<br>53<br>113 | Green ash, pin oak, black walnut. |
| 52-- Blackoar | 4W | Slight | Severe | Moderate | Moderate | Pin oak<br>Eastern cottonwood<br>Green ash | 80<br>95<br>--- | 62<br>116<br>--- | Pin oak, eastern cottonwood, pecan. |
| 53-- Chequest | 7W | Slight | Severe | Moderate | Moderate | Eastern cottonwood<br>Silver maple | 90<br>80 | 103<br>50 | Eastern cottonwood, American sycamore, green ash. |
| 55-- Piopolis | 5W | Slight | Severe | Severe | Severe | Pin oak<br>Eastern cottonwood<br>American sycamore | 90<br>100<br>--- | 72<br>178<br>--- | Eastern cottonwood, American sycamore, pin oak. |

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

| Soil name and map symbol | Ordination symbol | Management concerns: Erosion hazard | Management concerns: Equipment limitation | Management concerns: Seedling mortality | Management concerns: Windthrow hazard | Potential productivity: Common trees | Potential productivity: Site index | Potential productivity: Volume* | Trees to plant |
|---|---|---|---|---|---|---|---|---|---|
| 56 Darwin | 4W | Slight | Severe | Severe | Moderate | Pin oak | 80 | 62 | Eastern cottonwood, American sycamore, red maple, green ash, pin oak. |
| | | | | | | Swamp white oak | --- | --- | |
| | | | | | | Eastern cottonwood | --- | --- | |
| | | | | | | Green ash | --- | --- | |
| | | | | | | American sycamore | --- | --- | |
| 57 Floris | 3A | Slight | Slight | Slight | Slight | White oak | 63 | 3 | White oak, eastern cottonwood, eastern white pine, red pine, Scotch pine. |
| | | | | | | Eastern cottonwood | 105 | 10 | |
| 60E Lenzburg | 5R | Moderate | Moderate | Slight | Slight | Black walnut | 73 | 70 | Black walnut, eastern cottonwood, green ash, white ash. |
| | | | | | | Eastern cottonwood | --- | --- | |
| 60F Lenzburg | 5R | Severe | Severe | Slight | Slight | Black walnut | 73 | 70 | Black walnut, eastern cottonwood, green ash, white ash. |
| | | | | | | Eastern cottonwood | --- | --- | |
| 65 Dockery | 4A | Slight | Slight | Slight | Slight | Pin oak | 76 | 58 | Pin oak, pecan, eastern cottonwood. |
| 66 Tice | 5A | Slight | Slight | Slight | Slight | Pin oak | 96 | 78 | Eastern cottonwood, American sycamore, green ash, cherrybark oak. |
| | | | | | | Eastern cottonwood | --- | --- | |
| | | | | | | White ash | --- | --- | |
| 68 Bremer | 7W | Slight | Severe | Moderate | Moderate | Eastern cottonwood | 90 | 103 | Silver maple, eastern cottonwood, American sycamore, hackberry, green ash, northern whitecedar. |
| | | | | | | Silver maple | 80 | 50 | |
| 69 Floris | 3A | Slight | Slight | Slight | Slight | White oak | 63 | 46 | White oak, eastern cottonwood, eastern white pine. |
| | | | | | | Eastern cottonwood | 105 | 141 | |

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- <8 | 8-15 | 16-25 | 26-35 | >35 |
|---|---|---|---|---|---|
| 14C2, 14D2, 15C3, 15D3: Armstrong | --- | Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, Amur honeysuckle. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 16C2: Bevier | --- | American cranberrybush, Amur honeysuckle, Amur privet, arrowwood, Washington hawthorn, eastern redcedar. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 17C, 17E, 17E2, 17F, 17F2: Purdin | --- | American cranberrybush, Amur honeysuckle, Amur privet, arrowwood, Washington hawthorn, eastern redcedar. | Austrian pine, green ash. | Pin oak, eastern white pine. | --- |
| 18C2: Gorin | --- | Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush. | Green ash, Austrian pine. | Pin oak, eastern white pine. | --- |
| 19E2: Gosport | --- | Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 22F: Vanmeter | Siberian peashrub | Eastern redcedar, Russian-olive, Washington hawthorn. | Northern catalpa, honeylocust, green ash. | --- | --- |

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- <8 | 8-15 | 16-25 | 26-35 | >35 |
|---|---|---|---|---|---|
| 23C2, 23E3-------- Keswick | --- | Eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 26B2-------------- Leonard | --- | Amur honeysuckle, Amur privet, eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 27C, 27E2, 27F, 27F2------------- Winnegan | --- | American cranberrybush, Amur honeysuckle, Amur privet, arrowwood, Washington hawthorn, eastern redcedar. | Austrian pine, green ash. | Pin oak, eastern white pine. | --- |
| 30B--------------- Mexico | --- | Amur honeysuckle, American cranberrybush, arrowwood, eastern redcedar, Amur privet, Washington hawthorn. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 31---------------- Putnam | --- | American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | Eastern white pine | Pin oak. |
| 32B, 32B2--------- Adco | --- | American cranberrybush, Amur honeysuckle, Amur privet, arrowwood, Washington hawthorn, eastern redcedar. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 40---------------- Vesser | --- | Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | Eastern white pine | Pin oak. |

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- <8 | 8-15 | 16-25 | 26-35 | >35 |
|---|---|---|---|---|---|
| 41B<br>Marion | --- | Amur honeysuckle, American cranberrybush, Amur privet, eastern redcedar, Washington hawthorn, arrowwood. | Austrian pine, green ash. | Eastern white pine, pin oak. | --- |
| 42<br>Bremer | --- | Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush. | Norway spruce, Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn. | Eastern white pine | Pin oak. |
| 43<br>Chariton | --- | Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | Eastern white pine | Pin oak. |
| 44B, 44C2<br>Gifford | --- | Amur honeysuckle, Amur privet, eastern redcedar, arrowwood, Washington hawthorn, American cranberrybush. | Green ash, Austrian pine. | Pin oak, eastern white pine. | --- |
| 45A<br>Moniteau | --- | Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | Eastern white pine | Pin oak. |
| 46B<br>Vigar | --- | Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood. | Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn. | Norway spruce | Eastern white pine, pin oak. |
| 51<br>Wilbur | --- | Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood. | Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn. | Norway spruce | Eastern white pine, pin oak. |

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- <8 | 8-15 | 16-25 | 26-35 | >35 |
|---|---|---|---|---|---|
| 52 Blackoar | --- | Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | Eastern white pine | Pin oak. |
| 53 Chequest | --- | Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | Eastern white pine | Pin oak. |
| 55 Piopolis | --- | Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet. | Washington hawthorn, white fir, blue spruce, northern whitecedar, Austrian pine, Norway spruce. | Eastern white pine | Pin oak. |
| 56 Darwin | --- | Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush. | Austrian pine, northern whitecedar, blue spruce, Washington hawthorn, white fir. | Eastern white pine, Norway spruce. | Pin oak. |
| 57 Floris | --- | Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | --- | Pin oak, eastern white pine. |
| 58 Excello | --- | American cranberrybush, silky dogwood, Amur honeysuckle, Amur privet. | Austrian pine, northern whitecedar, Norway spruce, Washington hawthorn, eastern redcedar, white fir. | Eastern white pine | Pin oak. |
| 60E, 60F Lenzburg | Siberian peashrub | Eastern redcedar, Russian-olive, Washington hawthorn. | Honeylocust, northern catalpa. | --- | --- |
| 63B Zook | --- | Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet. | Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn. | Eastern white pine | Pin oak. |

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Soil name and map symbol | Trees having predicted 20-year average height, in feet, of-- <8 | 8-15 | 16-25 | 26-35 | >35 |
|---|---|---|---|---|---|
| 65. Dockery | --- | Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet. | Washington hawthorn, northern whitecedar, blue spruce, white fir, Austrian pine. | Norway spruce | Eastern white pine, pin oak. |
| 66. Tice | --- | Silky dogwood, Amur privet, American cranberrybush, Amur honeysuckle. | Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn. | Norway spruce | Eastern white pine, pin oak. |
| 67. Aquents | | | | | |
| 68. Bremer | --- | Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush. | Norway spruce, Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn. | Eastern white pine | Pin oak. |
| 69. Floris | --- | Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood. | Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn. | --- | Pin oak, eastern white pine. |

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| 14C2: Armstrong | Severe: wetness. | Moderate: wetness, percs slowly. | Severe: slope, wetness. | Moderate: wetness. | Moderate: wetness. |
| 14D2: Armstrong | Severe: wetness. | Moderate: slope, wetness, percs slowly. | Severe: slope, wetness. | Moderate: wetness. | Moderate: wetness, slope. |
| 15C3: Armstrong | Severe: wetness. | Moderate: wetness, percs slowly. | Severe: slope, wetness. | Severe: erodes easily. | Moderate: wetness. |
| 15D3: Armstrong | Severe: wetness. | Moderate: slope, wetness, percs slowly. | Severe: slope, wetness. | Severe: erodes easily. | Moderate: wetness, slope. |
| 16C2: Bevier | Moderate: wetness, percs slowly. | Moderate: wetness, percs slowly. | Moderate: slope, wetness, percs slowly. | Severe: erodes easily. | Slight. |
| 17C: Purdin | Moderate: wetness, percs slowly. | Moderate: wetness, percs slowly. | Severe: slope. | Slight | Slight. |
| 17E, 17E2: Purdin | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| 17F, 17F2: Purdin | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| 18C2: Gorin | Moderate: wetness, percs slowly. | Moderate: wetness, percs slowly. | Severe: slope. | Severe: erodes easily. | Slight. |
| 19E2: Gosport | Severe: slope, percs slowly. | Severe: slope, percs slowly. | Severe: slope, percs slowly. | Severe: erodes easily. | Severe: slope. |
| 22F: Vanmeter | Severe: slope, percs slowly. | Severe: slope, percs slowly. | Severe: slope, percs slowly. | Severe: slope, erodes easily. | Severe: slope. |
| 23C2: Keswick | Severe: wetness. | Moderate: wetness, percs slowly. | Severe: slope, wetness. | Severe: erodes easily. | Moderate: wetness. |
| 23E3: Keswick | Severe: slope, wetness. | Severe: slope. | Severe: slope, wetness. | Severe: erodes easily. | Severe: slope. |
| 26B2: Leonard | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. |

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| 27C Winnegan | Moderate: wetness, percs slowly. | Moderate: wetness, percs slowly. | Severe: slope. | Slight | Slight. |
| 27E2 Winnegan | Severe: slope. | Severe: slope. | Severe: slope. | Moderate: slope. | Severe: slope. |
| 27F, 27F2 Winnegan | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| 30B Mexico | Severe: wetness, percs slowly. | Severe: percs slowly. | Severe: wetness, percs slowly. | Moderate: wetness. | Moderate: wetness. |
| 31 Putnam | Severe: wetness, percs slowly. | Severe: wetness, percs slowly. | Severe: wetness, percs slowly. | Severe: wetness. | Severe: wetness. |
| 32B, 32B2 Adco | Severe: percs slowly. | Severe: percs slowly. | Severe: percs slowly. | Slight | Slight. |
| 40 Vesser | Severe: flooding, wetness. | Moderate: wetness. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, flooding. |
| 41B Marion | Severe: wetness, percs slowly. | Severe: percs slowly. | Severe: wetness, percs slowly. | Moderate: wetness. | Moderate: wetness. |
| 42 Bremer | Severe: flooding, wetness. | Moderate: wetness, percs slowly. | Severe: wetness. | Moderate: wetness. | Moderate: wetness. |
| 43 Chariton | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. |
| 44B Gifford | Severe: wetness, percs slowly. | Severe: wetness, percs slowly. | Severe: wetness, percs slowly. | Severe: wetness, erodes easily. | Severe: wetness. |
| 44C2 Gifford | Severe: wetness, percs slowly. | Severe: wetness, percs slowly. | Severe: slope, wetness, percs slowly. | Severe: wetness, erodes easily. | Severe: wetness. |
| 45A Moniteau | Severe: flooding, wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. |
| 46B Vigar | Severe: flooding. | Moderate: wetness, percs slowly. | Moderate: slope, wetness, percs slowly. | Slight | Slight. |
| 51 Wilbur | Severe: flooding. | Moderate: flooding, wetness. | Severe: flooding. | Moderate: wetness, flooding. | Severe: flooding. |
| 52 Blackoar | Severe: flooding, wetness. | Severe: wetness. | Severe: wetness, flooding. | Severe: wetness. | Severe: wetness, flooding. |

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| 53. Chequest | Severe: flooding, wetness. | Moderate: wetness, percs slowly. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, flooding. |
| 55. Piopolis | Severe: flooding, ponding. | Severe: ponding. | Severe: ponding, flooding. | Severe: ponding. | Severe: ponding, flooding. |
| 56. Darwin | Severe: flooding, ponding, percs slowly. | Severe: ponding, too clayey, percs slowly. | Severe: too clayey, ponding. | Severe: ponding, too clayey. | Severe: ponding, too clayey. |
| 57. Floris | Severe: flooding. | Moderate: flooding. | Severe: flooding. | Moderate: flooding. | Severe: flooding. |
| 58. Excello | Severe: flooding, wetness. | Moderate: flooding, wetness. | Severe: wetness, flooding. | Moderate: wetness, flooding. | Severe: flooding. |
| 60E. Lenzburg | Moderate: slope, percs slowly. | Moderate: slope, percs slowly. | Severe: slope. | Severe: erodes easily. | Moderate: large stones, slope. |
| 60F. Lenzburg | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope, erodes easily. | Severe: slope. |
| 63B. Zook | Severe: flooding, wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. | Severe: wetness. |
| 65. Dockery | Severe: flooding. | Moderate: wetness. | Moderate: wetness, flooding. | Slight | Moderate: flooding. |
| 66. Tice | Severe: flooding. | Moderate: flooding, wetness. | Severe: flooding. | Moderate: wetness, flooding. | Severe: flooding. |
| 67. Aquents | | | | | |
| 68. Bremer | Severe: flooding, wetness. | Moderate: wetness, percs slowly. | Severe: wetness. | Moderate: wetness. | Moderate: wetness, flooding. |
| 69. Floris | Severe: flooding. | Slight | Moderate: flooding. | Slight | Moderate: flooding. |

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

| Soil name and map symbol | Potential for habitat elements | | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Hardwood trees | Coniferous plants | Wetland plants | Shallow water areas | Openland wildlife | Woodland wildlife | Wetland wildlife |
| 14C2, 14D2, 15C3, 15D3 Armstrong | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| 16C2 Bevier | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| 17C Purdin | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| 17E, 17E2 Purdin | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| 17F, 17F2 Purdin | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Poor | Good | Very poor. |
| 18C2 Gorin | Fair | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| 19E2 Gosport | Poor | Poor | Fair | Fair | Fair | Very poor. | Very poor. | Poor | Fair | Very poor. |
| 22F Vanmeter | Very poor. | Poor | Fair | Fair | Fair | Very poor. | Very poor. | Poor | Fair | Very poor. |
| 23C2 Keswick | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| 23E3 Keswick | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| 26B2 Leonard | Fair | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| 27C Winnegan | Fair | Good | Good | Good | Good | Very poor. | Very poor. | Good | Good | Very poor. |
| 27E2 Winnegan | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| 27F, 27F2 Winnegan | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| 30B Mexico | Fair | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| 31 Putnam | Fair | Fair | Fair | Fair | Fair | Good | Good | Fair | Fair | Good. |
| 32B, 32B2 Adco | Fair | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| 40 Vesser | Good | Fair | Fair | Fair | Poor | Good | Good | Fair | Fair | Good. |
| 41B Marion | Fair | Fair | Fair | Fair | Fair | Poor | Very poor. | Fair | Fair | Very poor. |

TABLE 10.--WILDLIFE HABITAT--Continued

| Soil name and map symbol | Potential for habitat elements: Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Hardwood trees | Coniferous plants | Wetland plants | Shallow water areas | Potential as habitat for--: Openland wildlife | Woodland wildlife | Wetland wildlife |
|---|---|---|---|---|---|---|---|---|---|---|
| 42: Bremer | Good | Good | Good | Fair | Poor | Good | Good | Good | Fair | Good. |
| 43: Chariton | Fair | Fair | Fair | Fair | Fair | Good | Fair | Fair | Fair | Fair. |
| 44B, 44C2: Gifford | Fair | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| 45A: Moniteau | Fair | Fair | Fair | Fair | Fair | Good | Poor | Fair | Fair | Fair. |
| 46B: Vigar | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| 51: Wilbur | Good | Good | Good | Good | Good | Poor | Poor | Good | Good | Poor. |
| 52: Blackoar | Good | Good | Good | Fair | Fair | Good | Fair | Good | Fair | Fair. |
| 53: Chequest | Good | Fair | Fair | Fair | Poor | Good | Good | Fair | Fair | Good. |
| 55: Piopolis | Poor | Fair | Fair | Fair | Fair | Good | Good | Fair | Fair | Good. |
| 56: Darwin | Poor | Poor | Fair | Fair | Fair | Good | Good | Poor | Fair | Good. |
| 57: Floris | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |
| 58: Excello | Poor | Fair | Fair | Fair | Fair | Good | Good | Fair | Fair | Good. |
| 60E: Lenzburg | Poor | Fair | Good | Good | Good | Very poor. | Very poor. | Fair | Good | Very poor. |
| 60F: Lenzburg | Very poor. | Poor | Good | Good | Good | Very poor. | Very poor. | Poor | Good | Very poor. |
| 63B: Zook | Good | Fair | Good | Fair | Poor | Good | Good | Fair | Fair | Good. |
| 65: Dockery | Good | Good | Good | Good | Good | Fair | Fair | Good | Good | Fair. |
| 66: Tice | Poor | Fair | Fair | Good | Good | Fair | Fair | Fair | Good | Fair. |
| 67. Aquents | | | | | | | | | | |
| 68: Bremer | Good | Good | Good | Fair | Poor | Good | Good | Good | Fair | Good. |
| 69: Floris | Good | Good | Good | Good | Good | Poor | Very poor. | Good | Good | Very poor. |

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| 14C2: Armstrong | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell, low strength. | Moderate: wetness. |
| 14D2: Armstrong | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell, slope. | Severe: shrink-swell, low strength. | Moderate: wetness, slope. |
| 15C3: Armstrong | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell, low strength. | Moderate: wetness. |
| 15D3: Armstrong | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell, slope. | Severe: shrink-swell, low strength. | Moderate: wetness, slope. |
| 16C2: Bevier | Severe: wetness. | Severe: shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell, low strength, frost action. | Slight. |
| 17C: Purdin | Severe: wetness. | Severe: shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell, low strength. | Slight. |
| 17E, 17E2, 17F, 17F2: Purdin | Severe: wetness, slope. | Severe: shrink-swell, slope. | Severe: wetness, slope, shrink-swell. | Severe: shrink-swell, slope. | Severe: shrink-swell, low strength, slope. | Severe: slope. |
| 18C2: Gorin | Severe: wetness. | Severe: shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell, low strength, frost action. | Slight. |
| 19E2: Gosport | Severe: slope. | Severe: shrink-swell, slope. | Severe: slope. | Severe: shrink-swell, slope. | Severe: shrink-swell, low strength, slope. | Severe: slope. |
| 22F: Vanmeter | Severe: slope. | Severe: shrink-swell, slope. | Severe: slope. | Severe: shrink-swell, slope. | Severe: shrink-swell, low strength, slope. | Severe: slope. |
| 23C2: Keswick | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: shrink-swell, low strength. | Moderate: wetness. |
| 23E3: Keswick | Severe: wetness, slope. | Severe: wetness, shrink-swell, slope. | Severe: wetness, slope. | Severe: wetness, shrink-swell, slope. | Severe: shrink-swell, low strength, slope. | Severe: slope. |

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

| Soil name and map symbol | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| 26B2-------------- Leonard | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell, low strength, wetness. | Severe: wetness. |
| 27C--------------- Winnegan | Severe: wetness. | Severe: shrink-swell. | Severe: wetness. | Severe: shrink-swell. | Severe: shrink-swell, low strength. | Slight. |
| 27E2, 27F, 27F2--- Winnegan | Severe: wetness, slope. | Severe: shrink-swell, slope. | Severe: wetness, slope. | Severe: shrink-swell, slope. | Severe: shrink-swell, low strength, slope. | Severe: slope. |
| 30B--------------- Mexico | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell, low strength. | Moderate: wetness. |
| 31---------------- Putnam | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell, low strength, wetness. | Severe: wetness. |
| 32B, 32B2--------- Adco | Moderate: too clayey, wetness. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell, low strength, frost action. | Slight. |
| 40---------------- Vesser | Severe: wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: low strength, flooding, frost action. | Moderate: wetness, flooding. |
| 41B--------------- Marion | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: low strength, shrink-swell. | Moderate: wetness. |
| 42---------------- Bremer | Severe: wetness. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: shrink-swell, low strength. | Moderate: wetness. |
| 43---------------- Chariton | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: low strength, wetness, frost action. | Severe: wetness. |
| 44B, 44C2--------- Gifford | Severe: wetness. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: wetness, shrink-swell. | Severe: shrink-swell, low strength, wetness. | Severe: wetness. |
| 45A--------------- Moniteau | Severe: wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: low strength, wetness, flooding. | Severe: wetness. |
| 46B--------------- Vigar | Severe: wetness. | Severe: flooding. | Severe: flooding, wetness. | Severe: flooding. | Severe: low strength, frost action. | Slight. |

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

| Soil name and map symbol | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| 51---------------- Wilbur | Severe: wetness. | Severe: flooding. | Severe: flooding, wetness. | Severe: flooding. | Severe: flooding, frost action. | Severe: flooding. |
| 52---------------- Blackoar | Severe: wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: low strength, wetness, flooding. | Severe: wetness, flooding. |
| 53---------------- Chequest | Severe: wetness. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: shrink-swell, low strength, flooding. | Moderate: wetness, flooding. |
| 55---------------- Piopolis | Severe: ponding. | Severe: flooding, ponding. | Severe: flooding, ponding. | Severe: flooding, ponding. | Severe: low strength, ponding, flooding. | Severe: ponding, flooding. |
| 56---------------- Darwin | Severe: ponding. | Severe: flooding, ponding, shrink-swell. | Severe: flooding, ponding, shrink-swell. | Severe: flooding, ponding, shrink-swell. | Severe: shrink-swell, low strength, ponding. | Severe: ponding, too clayey. |
| 57---------------- Floris | Moderate: wetness, flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. |
| 58---------------- Excello | Severe: wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: low strength, flooding, frost action. | Severe: flooding. |
| 60E--------------- Lenzburg | Moderate: too clayey, slope. | Moderate: shrink-swell, slope. | Moderate: slope, shrink-swell. | Severe: slope. | Severe: low strength. | Moderate: large stones, slope. |
| 60F--------------- Lenzburg | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: low strength, slope. | Severe: slope. |
| 63B--------------- Zook | Severe: wetness. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: shrink-swell, low strength, wetness. | Severe: wetness. |
| 65---------------- Dockery | Severe: wetness. | Severe: flooding. | Severe: flooding, wetness. | Severe: flooding. | Severe: low strength, flooding, frost action. | Moderate: flooding. |
| 66---------------- Tice | Severe: wetness. | Severe: flooding. | Severe: flooding, wetness. | Severe: flooding. | Severe: low strength, flooding, frost action. | Severe: flooding. |
| 67. Aquents | | | | | | |
| 68---------------- Bremer | Severe: wetness. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: flooding, wetness, shrink-swell. | Severe: shrink-swell, low strength, flooding. | Moderate: wetness, flooding. |

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

| Soil name and map symbol | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| 69----------------- Floris | Moderate: wetness, flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Moderate: flooding. |

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| 14C2, 14D2, 15C3, 15D3 Armstrong | Severe: wetness, percs slowly. | Severe: slope. | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack. |
| 16C2 Bevier | Severe: wetness, percs slowly. | Severe: slope. | Moderate: wetness, too clayey. | Moderate: wetness. | Poor: hard to pack. |
| 17C Purdin | Severe: wetness, percs slowly. | Severe: slope. | Severe: too clayey. | Moderate: wetness. | Poor: too clayey. |
| 17E, 17E2, 17F, 17F2 Purdin | Severe: wetness, percs slowly, slope. | Severe: slope. | Severe: slope, too clayey. | Severe: slope. | Poor: too clayey, slope. |
| 18C2 Gorin | Severe: wetness, percs slowly. | Severe: slope. | Severe: too clayey. | Moderate: wetness. | Poor: too clayey, hard to pack. |
| 19E2 Gosport | Severe: depth to rock, percs slowly, slope. | Severe: depth to rock, slope. | Severe: depth to rock, slope. | Severe: depth to rock, slope. | Poor: depth to rock, slope. |
| 22F Vanmeter | Severe: depth to rock, percs slowly, slope. | Severe: depth to rock, slope. | Severe: depth to rock, slope. | Severe: depth to rock, slope. | Poor: depth to rock, slope. |
| 23C2 Keswick | Severe: wetness, percs slowly. | Severe: slope. | Severe: wetness. | Severe: wetness. | Poor: wetness. |
| 23E3 Keswick | Severe: wetness, percs slowly, slope. | Severe: slope. | Severe: wetness, slope. | Severe: wetness, slope. | Poor: slope, wetness. |
| 26B2 Leonard | Severe: wetness, percs slowly. | Moderate: slope. | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack, wetness. |
| 27C Winnegan | Severe: wetness, percs slowly. | Severe: slope. | Moderate: wetness, too clayey. | Moderate: wetness. | Fair: too clayey, wetness. |
| 27E2, 27F, 27F2 Winnegan | Severe: wetness, percs slowly, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Poor: slope. |

TABLE 12.--SANITARY FACILITIES--Continued

| Soil name and map symbol | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| 30B------------------ Mexico | Severe: wetness, percs slowly. | Moderate: slope. | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack, wetness. |
| 31------------------- Putnam | Severe: wetness, percs slowly. | Slight--------------- | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack, wetness. |
| 32B, 32B2----------- Adco | Severe: wetness, percs slowly. | Moderate: slope. | Severe: too clayey. | Moderate: wetness. | Poor: too clayey, hard to pack. |
| 40------------------- Vesser | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Poor: wetness. |
| 41B------------------ Marion | Severe: wetness, percs slowly. | Moderate: slope. | Severe: wetness. | Severe: wetness. | Poor: wetness. |
| 42------------------- Bremer | Severe: wetness, percs slowly. | Severe: wetness. | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack, wetness. |
| 43------------------- Chariton | Severe: wetness, percs slowly. | Slight--------------- | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack, wetness. |
| 44B------------------ Gifford | Severe: wetness, percs slowly. | Moderate: slope. | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack, wetness. |
| 44C2----------------- Gifford | Severe: wetness, percs slowly. | Severe: slope. | Severe: wetness, too clayey. | Severe: wetness. | Poor: too clayey, hard to pack, wetness. |
| 45A------------------ Moniteau | Severe: flooding, wetness, percs slowly. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Poor: wetness. |
| 46B------------------ Vigar | Severe: wetness, percs slowly. | Moderate: slope. | Severe: wetness. | Severe: wetness. | Fair: too clayey, wetness. |
| 51------------------- Wilbur | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Fair: wetness. |
| 52------------------- Blackoar | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Poor: wetness. |
| 53------------------- Chequest | Severe: flooding, wetness, percs slowly. | Severe: flooding, wetness. | Severe: flooding, wetness, too clayey. | Severe: flooding, wetness. | Poor: too clayey, hard to pack, wetness. |

TABLE 12.--SANITARY FACILITIES--Continued

| Soil name and map symbol | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| 55. Piopolis | Severe: flooding, ponding, percs slowly. | Severe: flooding, ponding. | Severe: flooding, ponding. | Severe: flooding, ponding. | Poor: ponding. |
| 56. Darwin | Severe: flooding, ponding, percs slowly. | Severe: flooding, ponding. | Severe: flooding, ponding, too clayey. | Severe: flooding, ponding. | Poor: too clayey, hard to pack, ponding. |
| 57. Floris | Severe: flooding, wetness. | Severe: seepage, flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, seepage, wetness. | Fair: too clayey, wetness. |
| 58. Excello | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Poor: wetness. |
| 60E. Lenzburg | Severe: percs slowly. | Severe: slope. | Moderate: slope, too clayey. | Moderate: slope. | Fair: too clayey, small stones, slope. |
| 60F. Lenzburg | Severe: percs slowly, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Poor: slope. |
| 63B. Zook | Severe: flooding, wetness, percs slowly. | Severe: flooding. | Severe: flooding, wetness, too clayey. | Severe: flooding, wetness. | Poor: too clayey, hard to pack, wetness. |
| 65. Dockery | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Fair: too clayey, wetness. |
| 66. Tice | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, wetness. | Poor: hard to pack. |
| 67. Aquents | | | | | |
| 68. Bremer | Severe: flooding, wetness, percs slowly. | Severe: flooding, wetness. | Severe: flooding, wetness, too clayey. | Severe: flooding, wetness. | Poor: too clayey, hard to pack, wetness. |
| 69. Floris | Severe: flooding, wetness. | Severe: seepage, flooding, wetness. | Severe: flooding, wetness. | Severe: flooding, seepage, wetness. | Fair: too clayey, wetness. |

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| 14C2, 14D2, 15C3, 15D3: Armstrong | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 16C2: Bevier | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 17C: Purdin | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 17E, 17E2: Purdin | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, slope. |
| 17F, 17F2: Purdin | Poor: low strength, slope. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, slope. |
| 18C2: Gorin | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 19E2: Gosport | Poor: depth to rock. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, slope. |
| 22F: Vanmeter | Poor: depth to rock, slope. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, slope. |
| 23C2: Keswick | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 23E3: Keswick | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, slope. |
| 26B2: Leonard | Poor: low strength, wetness, shrink-swell. | Improbable: excess fines. | Improbable: excess fines. | Poor: thin layer, wetness. |
| 27C: Winnegan | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 27E2: Winnegan | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, slope. |
| 27F, 27F2: Winnegan | Poor: low strength, slope. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, slope. |
| 30B: Mexico | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |

TABLE 13.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| 31------------------- Putnam | Poor: low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: thin layer, wetness. |
| 32B, 32B2------------- Adco | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 40------------------- Vesser | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Good. |
| 41B------------------ Marion | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: thin layer. |
| 42------------------- Bremer | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 43------------------- Chariton | Poor: wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: thin layer, wetness. |
| 44B, 44C2------------- Gifford | Poor: low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, wetness. |
| 45A------------------ Moniteau | Poor: low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: wetness. |
| 46B------------------ Vigar | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: small stones. |
| 51------------------- Wilbur | Fair: wetness. | Improbable: excess fines. | Improbable: excess fines. | Good. |
| 52------------------- Blackoar | Poor: low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: wetness. |
| 53------------------- Chequest | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 55------------------- Piopolis | Poor: low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: wetness. |
| 56------------------- Darwin | Poor: shrink-swell, low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, wetness. |
| 57------------------- Floris | Fair: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Good. |
| 58------------------- Excello | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 60E------------------ Lenzburg | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones, area reclaim. |

TABLE 13.--CONSTRUCTION MATERIALS--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| 60F------------------- Lenzburg | Poor: low strength, slope. | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones, area reclaim, slope. |
| 63B------------------- Zook | Poor: shrink-swell, low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: wetness. |
| 65-------------------- Dockery | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 66-------------------- Tice | Fair: low strength, wetness, shrink-swell. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 67. Aquents | | | | |
| 68-------------------- Bremer | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 69-------------------- Floris | Fair: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Good. |

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

| Soil name and map symbol | Limitations for-- | | Features affecting-- | | | |
|---|---|---|---|---|---|---|
| | Pond reservoir areas | Embankments, dikes, and levees | Drainage | Irrigation | Terraces and diversions | Grassed waterways |
| 14C2 Armstrong | Moderate: slope. | Severe: hard to pack. | Percs slowly, frost action, slope. | Slope, wetness, percs slowly. | Wetness, percs slowly. | Wetness, percs slowly. |
| 14D2 Armstrong | Severe: slope. | Severe: hard to pack. | Percs slowly, frost action, slope. | Slope, wetness, percs slowly. | Slope, wetness, percs slowly. | Wetness, slope, percs slowly. |
| 15C3 Armstrong | Moderate: slope. | Severe: hard to pack. | Percs slowly, frost action, slope. | Slope, wetness, percs slowly. | Erodes easily, wetness. | Wetness, erodes easily. |
| 15D3 Armstrong | Severe: slope. | Severe: hard to pack. | Percs slowly, frost action, slope. | Slope, wetness, percs slowly. | Slope, erodes easily, wetness. | Wetness, slope, erodes easily. |
| 16C2 Bevier | Moderate: slope. | Moderate: hard to pack, wetness. | Percs slowly, frost action, slope. | Slope, wetness, percs slowly. | Erodes easily, wetness. | Erodes easily, percs slowly. |
| 17C Purdin | Moderate: slope. | Moderate: wetness. | Percs slowly, slope. | Slope, wetness, percs slowly. | Wetness, percs slowly. | Percs slowly. |
| 17E, 17E2, 17F, 17F2 Purdin | Severe: slope. | Moderate: wetness. | Percs slowly, slope. | Slope, wetness, percs slowly. | Slope, wetness, percs slowly. | Slope, percs slowly. |
| 18C2 Gorin | Moderate: slope. | Moderate: thin layer, hard to pack, wetness. | Percs slowly, frost action, slope. | Slope, wetness, percs slowly. | Erodes easily, wetness. | Erodes easily, percs slowly. |
| 19E2 Gosport | Severe: slope. | Slight | Deep to water | Slope, percs slowly, depth to rock. | Slope, depth to rock, erodes easily. | Slope, erodes easily, depth to rock. |
| 22F Vanmeter | Severe: slope. | Slight | Deep to water | Slope, percs slowly, depth to rock. | Slope, depth to rock, erodes easily. | Slope, erodes easily, depth to rock. |
| 23C2 Keswick | Moderate: slope. | Moderate: wetness. | Percs slowly, frost action, slope. | Slope, wetness, percs slowly. | Erodes easily, wetness. | Wetness, erodes easily. |
| 23E3 Keswick | Severe: slope. | Moderate: wetness. | Percs slowly, frost action, slope. | Slope, wetness. | Slope, erodes easily, wetness. | Wetness, slope, erodes easily. |
| 26B2 Leonard | Moderate: slope. | Severe: wetness. | Percs slowly, frost action, slope. | Wetness, percs slowly, slope. | Erodes easily, wetness. | Wetness, erodes easily. |
| 27C Winnegan | Moderate: slope. | Moderate: wetness. | Percs slowly, slope. | Slope, wetness, percs slowly. | Wetness | Percs slowly. |

TABLE 14.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Limitations for-- Pond reservoir areas | Embankments, dikes, and levees | Features affecting-- Drainage | Irrigation | Terraces and diversions | Grassed waterways |
|---|---|---|---|---|---|---|
| 27E2, 27F, 27F2---Winnegan | Severe: slope. | Moderate: wetness. | Percs slowly, slope. | Slope, wetness, percs slowly. | Slope, wetness. | Slope, percs slowly. |
| 30B---Mexico | Slight | Moderate: hard to pack, wetness. | Percs slowly | Wetness, percs slowly. | Erodes easily, wetness. | Wetness, erodes easily, percs slowly. |
| 31---Putnam | Slight | Severe: wetness. | Percs slowly | Wetness, percs slowly, erodes easily. | Erodes easily, wetness, percs slowly. | Wetness, erodes easily, percs slowly. |
| 32B, 32B2---Adco | Slight | Severe: hard to pack. | Percs slowly, frost action. | Wetness, percs slowly. | Erodes easily, wetness, percs slowly. | Erodes easily, percs slowly. |
| 40---Vesser | Moderate: seepage, slope. | Severe: wetness. | Flooding, frost action, slope. | Slope, wetness, flooding. | Erodes easily, wetness. | Wetness, erodes easily. |
| 41B---Marion | Slight | Moderate: wetness. | Percs slowly | Wetness, percs slowly. | Erodes easily, wetness, percs slowly. | Wetness, erodes easily, percs slowly. |
| 42---Bremer | Slight | Severe: hard to pack, wetness. | Frost action | Wetness | Erodes easily, wetness. | Wetness, erodes easily. |
| 43---Chariton | Moderate: seepage. | Severe: hard to pack, wetness. | Percs slowly, frost action. | Wetness, percs slowly, erodes easily. | Erodes easily, wetness, percs slowly. | Wetness, erodes easily, percs slowly. |
| 44B, 44C2---Gifford | Moderate: slope. | Severe: wetness. | Percs slowly, slope. | Slope, wetness, percs slowly. | Erodes easily, wetness. | Wetness, erodes easily. |
| 45A---Moniteau | Slight | Severe: wetness. | Flooding, frost action. | Wetness, erodes easily. | Erodes easily, wetness. | Wetness, erodes easily. |
| 46B---Vigar | Moderate: slope. | Moderate: wetness. | Frost action, slope. | Slope, wetness. | Wetness | Favorable. |
| 51---Wilbur | Moderate: seepage. | Severe: piping, wetness. | Flooding, frost action. | Wetness, erodes easily, flooding. | Erodes easily, wetness. | Erodes easily. |
| 52---Blackoar | Moderate: seepage. | Severe: piping, wetness. | Flooding, frost action. | Wetness, flooding. | Erodes easily, wetness. | Wetness, erodes easily. |
| 53---Chequest | Slight | Severe: wetness. | Flooding, frost action. | Wetness, flooding. | Erodes easily, wetness. | Wetness, erodes easily. |
| 55---Piopolis | Slight | Severe: ponding. | Ponding, percs slowly, flooding. | Ponding, percs slowly, erodes easily. | Erodes easily, ponding, percs slowly. | Wetness, erodes easily, percs slowly. |
| 56---Darwin | Slight | Severe: hard to pack, ponding. | Ponding, percs slowly, flooding. | Ponding, slow intake, percs slowly. | Ponding, percs slowly. | Wetness, percs slowly. |
| 57---Floris | Severe: seepage. | Severe: piping. | Deep to water | Flooding | Erodes easily | Erodes easily. |

TABLE 14.--WATER MANAGEMENT--Continued

| Soil name and map symbol | Limitations for-- Pond reservoir areas | Embankments, dikes, and levees | Features affecting-- Drainage | Irrigation | Terraces and diversions | Grassed waterways |
|---|---|---|---|---|---|---|
| 58----------------- Excello | Moderate: seepage. | Severe: wetness. | Flooding, frost action. | Wetness, flooding. | Wetness--------- | Wetness. |
| 60E, 60F---------- Lenzburg | Severe: slope. | Moderate: piping. | Deep to water | Slope, erodes easily. | Slope, erodes easily. | Slope, erodes easily. |
| 63B--------------- Zook | Moderate: slope. | Severe: hard to pack, wetness. | Percs slowly, flooding, frost action. | Slope, wetness, percs slowly. | Wetness, percs slowly. | Wetness, percs slowly. |
| 65----------------- Dockery | Moderate: seepage. | Moderate: piping, wetness. | Flooding, frost action. | Wetness, erodes easily. | Erodes easily, wetness. | Erodes easily. |
| 66----------------- Tice | Moderate: seepage. | Severe: wetness. | Flooding, frost action. | Wetness--------- | Wetness--------- | Favorable. |
| 67. Aquents | | | | | | |
| 68----------------- Bremer | Slight---------- | Severe: hard to pack, wetness. | Flooding, frost action. | Wetness, flooding. | Erodes easily, wetness. | Wetness, erodes easily. |
| 69----------------- Floris | Severe: seepage. | Severe: piping. | Deep to water | Flooding-------- | Erodes easily | Erodes easily. |

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

| Soil name and map symbol | Depth | USDA texture | Classification | | Frag- ments > 10 inches | Frag- ments 3-10 inches | Percentage passing sieve number-- | | | | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | Pct | | | | | Pct | |
| 14C2, 14D2---- Armstrong | 0-6 | Loam---------- | CL, CL-ML | A-6, A-4 | 0 | 0-5 | 90-100 | 80-95 | 75-90 | 55-80 | 20-30 | 5-15 |
| | 6-41 | Clay loam, clay, silty clay loam. | CL, CH, ML, MH | A-7 | 0 | 0-5 | 90-100 | 80-95 | 70-90 | 55-80 | 45-70 | 20-35 |
| | 41-60 | Clay loam----- | CL | A-6 | 0 | 0-5 | 90-100 | 80-95 | 70-90 | 55-80 | 30-40 | 15-20 |
| 15C3, 15D3---- Armstrong | 0-4 | Clay loam----- | CL | A-6, A-7 | 0 | 0-5 | 90-100 | 80-95 | 75-90 | 55-80 | 35-45 | 15-25 |
| | 4-25 | Clay loam, clay, silty clay loam. | CL, CH, ML, MH | A-7 | 0 | 0-5 | 90-100 | 80-95 | 70-90 | 55-80 | 45-70 | 20-35 |
| | 25-60 | Clay loam----- | CL | A-6 | 0 | 0-5 | 90-100 | 80-95 | 70-90 | 55-80 | 30-40 | 15-20 |
| 16C2---------- Bevier | 0-6 | Silty clay loam. | CL | A-7 | 0 | 0 | 100 | 100 | 95-100 | 85-95 | 42-48 | 22-27 |
| | 6-22 | Silty clay, silty clay loam. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 85-95 | 55-65 | 30-40 |
| | 22-34 | Silty clay loam. | CL, CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 85-95 | 43-56 | 20-33 |
| | 34-60 | Silt loam, loam, clay loam. | CL, CH | A-6, A-7 | 0 | 0 | 95-100 | 95-100 | 80-100 | 55-85 | 36-56 | 17-33 |
| 17C, 17E, 17E2, 17F---- Purdin | 0-5 | Loam---------- | CL-ML, CL | A-4, A-6 | 0 | 0 | 95-100 | 95-100 | 80-95 | 60-80 | 20-30 | 5-15 |
| | 5-10 | Clay loam----- | CL | A-6, A-7 | 0 | 0 | 95-100 | 95-100 | 80-95 | 60-75 | 35-45 | 15-25 |
| | 10-25 | Clay loam, clay. | CL | A-6, A-7 | 0 | 0 | 95-100 | 95-100 | 85-95 | 65-85 | 35-50 | 15-25 |
| | 25-40 | Clay loam, clay. | CL | A-7 | 0 | 0 | 95-100 | 95-100 | 85-95 | 65-85 | 40-50 | 15-25 |
| | 40-60 | Clay loam, loam. | CL | A-6 | 0 | 0 | 95-100 | 95-100 | 80-95 | 60-80 | 30-40 | 11-20 |
| 17F2---------- Purdin | 0-5 | Clay loam----- | CL | A-6 | 0 | 0 | 95-100 | 95-100 | 70-85 | 60-75 | 30-40 | 11-20 |
| | 5-27 | Clay loam, clay. | CL | A-6, A-7 | 0 | 0 | 95-100 | 95-100 | 85-95 | 65-85 | 35-50 | 15-25 |
| | 27-44 | Clay loam, clay. | CL | A-7 | 0 | 0 | 95-100 | 95-100 | 85-95 | 65-85 | 40-50 | 15-25 |
| | 44-60 | Clay loam, loam. | CL | A-6 | 0 | 0 | 95-100 | 95-100 | 80-95 | 60-80 | 30-40 | 11-20 |
| 18C2---------- Gorin | 0-5 | Silt loam----- | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 95-100 | 85-100 | 25-40 | 5-18 |
| | 5-8 | Silty clay loam, silty clay. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 35-50 | 15-30 |
| | 8-24 | Silty clay, silty clay loam. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 50-65 | 30-40 |
| | 24-45 | Silty clay loam, clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 80-95 | 70-90 | 30-50 | 12-30 |
| | 45-60 | Loam, silt loam. | CL | A-4, A-6 | 0 | 0 | 100 | 95-100 | 85-100 | 65-90 | 25-35 | 8-15 |
| 19E2---------- Gosport | 0-12 | Loam---------- | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 90-100 | 80-90 | 60-80 | 25-40 | 5-15 |
| | 12-22 | Clay, silty clay, silty clay loam. | CH | A-7 | 0 | 0 | 100 | 90-100 | 90-100 | 85-100 | 50-65 | 35-50 |
| | 22-60 | Weathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Fragments > 10 inches | Fragments 3-10 inches | Percentage passing sieve number-- 4 | 10 | 40 | 200 | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | Pct | | | | | Pct | |
| 22F----------- Vanmeter | 0-7 | Loam---------- | CL, CL-ML | A-4, A-6 | 0 | 0-5 | 95-100 | 75-100 | 70-100 | 65-80 | 25-40 | 5-15 |
| | 7-30 | Silty clay, clay. | CH, CL | A-7 | 0 | 0-5 | 95-100 | 75-100 | 70-100 | 65-100 | 40-65 | 24-40 |
| | 30-60 | Weathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23C2---------- Keswick | 0-6 | Clay loam----- | CL | A-6, A-7 | 0 | 0-5 | 90-100 | 80-100 | 75-90 | 60-80 | 35-50 | 15-25 |
| | 6-38 | Clay loam, clay. | CH, CL | A-7 | 0 | 0-5 | 90-100 | 80-100 | 70-90 | 55-80 | 40-70 | 20-40 |
| | 38-60 | Clay loam----- | CL | A-6 | 0 | 0-5 | 90-100 | 80-100 | 70-90 | 55-80 | 30-40 | 15-25 |
| 23E3---------- Keswick | 0-5 | Clay loam----- | CL | A-6, A-7 | 0 | 0-5 | 90-100 | 80-100 | 75-90 | 60-80 | 35-50 | 15-25 |
| | 5-28 | Clay loam, clay. | CH, CL | A-7 | 0 | 0-5 | 90-100 | 80-100 | 70-90 | 55-80 | 40-70 | 20-40 |
| | 28-60 | Clay loam----- | CL | A-6 | 0 | 0-5 | 90-100 | 80-100 | 70-90 | 55-80 | 30-40 | 15-25 |
| 26B2---------- Leonard | 0-8 | Silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 95-100 | 90-100 | 85-100 | 30-45 | 15-25 |
| | 8-13 | Silty clay loam, silty clay. | CL | A-6, A-7 | 0 | 0 | 100 | 95-100 | 90-100 | 85-100 | 35-50 | 20-30 |
| | 13-35 | Silty clay, clay, silty clay loam. | CH | A-7 | 0 | 0 | 100 | 95-100 | 85-100 | 80-100 | 55-70 | 30-40 |
| | 35-60 | Silty clay, clay loam, silty clay loam. | CL, CH | A-7 | 0 | 0 | 95-100 | 95-100 | 80-95 | 75-90 | 45-60 | 25-35 |
| 27C, 27E2, 27F, 27F2---- Winnegan | 0-3 | Loam---------- | CL-ML, CL | A-4, A-6 | 0 | 0 | 95-100 | 95-100 | 80-90 | 60-80 | 20-30 | 5-15 |
| | 3-6 | Loam, clay loam. | CL-ML, CL | A-4, A-6 | 0 | 0 | 95-100 | 95-100 | 80-90 | 60-80 | 20-30 | 5-15 |
| | 6-36 | Clay loam, clay. | CL | A-7 | 0 | 0 | 95-100 | 95-100 | 85-95 | 65-85 | 40-50 | 20-30 |
| | 36-49 | Clay loam, clay. | CL | A-7 | 0 | 0 | 95-100 | 95-100 | 85-95 | 65-85 | 40-50 | 20-30 |
| | 49-60 | Clay loam, loam. | CL | A-6 | 0 | 0 | 95-100 | 95-100 | 85-95 | 60-80 | 25-40 | 10-20 |
| 30B----------- Mexico | 0-11 | Silt loam----- | CL-ML, CL | A-4, A-6 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 25-40 | 5-15 |
| | 11-15 | Silty clay loam, silty clay. | CL, CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 45-60 | 25-35 |
| | 15-36 | Silty clay, clay. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 60-75 | 30-45 |
| | 36-53 | Silty clay loam, silty clay. | CL, CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 45-60 | 25-35 |
| | 53-60 | Silty clay loam, clay loam, silty clay. | CL, CH | A-7 | 0 | 0 | 100 | 95-100 | 90-100 | 70-100 | 40-65 | 15-40 |
| 31------------ Putnam | 0-9 | Silt loam----- | CL, ML | A-6, A-4 | 0 | 0 | 100 | 100 | 90-100 | 85-100 | 30-40 | 5-15 |
| | 9-16 | Silt loam----- | CL, ML | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-100 | 30-40 | 5-15 |
| | 16-31 | Silty clay, clay. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 60-70 | 35-45 |
| | 31-45 | Silty clay loam, silty clay. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 50-65 | 25-40 |
| | 45-60 | Silty clay loam. | CL | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 40-50 | 20-30 |

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture | Classification | | Frag- ments > 10 inches | Frag- ments 3-10 inches | Percentage passing sieve number-- | | | | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | Pct | | | | | Pct | |
| 32B, 32B2----- Adco | 0-8 | Silt loam----- | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 100 | 95-100 | 30-45 | 13-25 |
| | 8-12 | Silt loam, silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 100 | 95-100 | 30-45 | 13-25 |
| | 12-23 | Silty clay---- | CH | A-7 | 0 | 0 | 100 | 100 | 100 | 95-100 | 66-76 | 41-49 |
| | 23-46 | Silty clay loam, silty clay. | CL, CH | A-7 | 0 | 0 | 100 | 100 | 100 | 90-100 | 43-66 | 22-41 |
| | 46-60 | Silt loam, silty clay loam, clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 95-100 | 75-100 | 31-51 | 13-29 |
| 40------------ Vesser | 0-12 | Silt loam----- | CL | A-6 | 0 | 0 | 100 | 100 | 98-100 | 95-100 | 30-40 | 10-20 |
| | 12-24 | Silt loam----- | CL | A-6 | 0 | 0 | 100 | 100 | 98-100 | 95-100 | 30-40 | 10-20 |
| | 24-60 | Silty clay loam. | CL | A-7 | 0 | 0 | 100 | 100 | 98-100 | 95-100 | 40-50 | 15-25 |
| 41B----------- Marion | 0-18 | Silt loam----- | ML, CL | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 90-100 | 30-40 | 5-15 |
| | 18-36 | Silty clay---- | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 50-65 | 30-40 |
| | 36-60 | Silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 95-100 | 85-95 | 35-45 | 20-25 |
| 42------------ Bremer | 0-18 | Silt loam----- | CL, ML | A-6, A-7 | 0 | 0 | 100 | 100 | 100 | 95-100 | 35-45 | 10-20 |
| | 18-44 | Silty clay loam, silty clay. | CH, MH | A-7 | 0 | 0 | 100 | 100 | 100 | 95-100 | 50-65 | 20-35 |
| | 44-60 | Silty clay loam. | CH, CL | A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 40-60 | 25-40 |
| 43------------ Chariton | 0-9 | Silt loam----- | CL-ML, CL | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 70-90 | 25-35 | 5-15 |
| | 9-15 | Silt loam----- | CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 70-90 | 25-35 | 5-15 |
| | 15-18 | Silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 95-100 | 85-95 | 35-45 | 15-25 |
| | 18-37 | Silty clay---- | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-95 | 55-75 | 40-50 |
| | 37-46 | Silty clay loam. | CL, CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 85-95 | 45-55 | 25-35 |
| | 46-60 | Sandy clay loam, fine sandy loam, clay loam. | CL, SC, CL-ML, SC-SM | A-6, A-4 | 0 | 0 | 100 | 100 | 80-95 | 40-70 | 20-35 | 5-20 |
| 44B----------- Gifford | 0-7 | Silt loam----- | CL | A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-95 | 30-40 | 10-20 |
| | 7-10 | Silty clay loam. | CL | A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-95 | 30-40 | 10-20 |
| | 10-39 | Silty clay, silty clay loam. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 50-65 | 30-40 |
| | 39-60 | Silty clay loam, clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 85-100 | 75-90 | 35-45 | 20-25 |
| 44C2---------- Gifford | 0-5 | Silt loam----- | CL | A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-95 | 30-40 | 10-20 |
| | 5-10 | Silty clay, silty clay loam. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 50-65 | 30-40 |
| | 10-33 | Silty clay loam, clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 85-100 | 75-90 | 35-45 | 20-25 |
| | 33-60 | Loam, silt loam. | CL | A-6 | 0 | 0 | 100 | 100 | 95-100 | 85-100 | 30-40 | 10-20 |

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Fragments > 10 inches | Fragments 3-10 inches | Percentage passing sieve number-- 4 | 10 | 40 | 200 | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | Pct | | | | | Pct | |
| 45A----------- Moniteau | 0-9 | Silt loam----- | CL-ML, CL | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-100 | 25-35 | 5-15 |
| | 9-22 | Silt loam----- | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-100 | 25-35 | 5-15 |
| | 22-60 | Silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 85-100 | 80-95 | 30-45 | 15-25 |
| 46B----------- Vigar | 0-20 | Loam---------- | CL-ML, CL | A-4, A-6 | 0 | 0 | 95-100 | 90-100 | 85-95 | 60-75 | 20-30 | 5-15 |
| | 20-60 | Clay loam, silty clay loam, loam. | CL | A-6 | 0 | 0 | 95-100 | 90-100 | 70-95 | 60-90 | 30-40 | 15-25 |
| 51------------ Wilbur | 0-8 | Silt loam----- | ML, CL-ML | A-4 | 0 | 0 | 100 | 100 | 90-100 | 70-90 | <25 | 3-7 |
| | 8-60 | Silt loam----- | ML, CL-ML | A-4 | 0 | 0 | 100 | 100 | 90-100 | 70-90 | <25 | 3-7 |
| 52------------ Blackoar | 0-16 | Silt loam----- | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 95-100 | 85-100 | 25-40 | 5-18 |
| | 16-42 | Silt loam----- | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 95-100 | 85-100 | 25-40 | 5-18 |
| | 42-60 | Silt loam, silty clay loam. | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 95-100 | 85-100 | 25-40 | 5-20 |
| 53------------ Chequest | 0-10 | Silty clay loam. | CL | A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 40-50 | 15-25 |
| | 10-60 | Silty clay loam, silty clay. | CL, CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 45-60 | 20-30 |
| 55------------ Piopolis | 0-9 | Silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 90-100 | 75-95 | 35-50 | 15-25 |
| | 9-42 | Silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 90-100 | 85-95 | 35-50 | 15-25 |
| | 42-60 | Silty clay loam, silt loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 90-100 | 70-95 | 35-50 | 15-25 |
| 56------------ Darwin | 0-11 | Silty clay---- | CH, CL | A-7 | 0 | 0 | 100 | 100 | 100 | 90-100 | 45-85 | 25-55 |
| | 11-45 | Silty clay, clay. | CH, CL | A-7 | 0 | 0 | 100 | 100 | 100 | 85-100 | 45-85 | 25-55 |
| | 45-60 | Silty clay loam, silty clay. | CL, CH | A-7, A-6 | 0 | 0 | 100 | 100 | 95-100 | 90-100 | 35-70 | 20-45 |
| 57------------ Floris | 0-13 | Loam---------- | CL, ML, CL-ML | A-4 | 0 | 0 | 100 | 95-100 | 90-100 | 50-75 | <30 | 3-10 |
| | 13-30 | Fine sandy loam, sandy loam. | SM, SC, SC-SM | A-2-4, A-4 | 0 | 0 | 100 | 95-100 | 65-95 | 20-45 | <30 | NP-10 |
| | 30-60 | Loam, silt loam, silty clay loam. | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 95-100 | 70-100 | 25-35 | 5-15 |
| 58------------ Excello | 0-13 | Silt loam----- | CL | A-6 | 0 | 0 | 100 | 100 | 85-100 | 60-90 | 30-40 | 11-20 |
| | 13-43 | Loam, clay loam, sandy clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 80-100 | 50-95 | 30-50 | 11-30 |
| | 43-60 | Loam, clay loam, sandy clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 80-100 | 50-80 | 30-50 | 11-30 |
| 60E, 60F------ Lenzburg | 0-3 | Clay loam----- | CL | A-6, A-7 | 0-1 | 2-10 | 80-100 | 75-100 | 65-95 | 55-85 | 35-50 | 15-25 |
| | 3-60 | Silt loam, silty clay loam, clay loam. | CL | A-6, A-7 | 0-2 | 2-10 | 80-95 | 75-90 | 70-90 | 55-85 | 25-45 | 10-25 |

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Fragments > 10 inches | Fragments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | Pct | | | | | Pct | |
| 63B-----------<br>Zook | 0-12 | Silty clay loam. | CH, CL | A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 45-65 | 20-35 |
| | 12-50 | Silty clay, silty clay loam. | CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 60-85 | 35-55 |
| | 50-60 | Silty clay, silty clay loam, silt loam. | CH, CL, ML | A-6, A-7 | 0 | 0 | 100 | 100 | 95-100 | 95-100 | 35-85 | 10-50 |
| 65------------<br>Dockery | 0-8 | Silt loam----- | CL-ML, CL | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-100 | 25-35 | 5-15 |
| | 8-36 | Silt loam, silty clay loam. | CL, SC | A-4, A-6 | 0 | 0 | 100 | 100 | 90-100 | 85-95 | 25-40 | 8-20 |
| | 36-60 | Stratified sandy loam to silt loam. | CL-ML, CL | A-4, A-6 | 0 | 0 | 100 | 100 | 65-95 | 35-85 | 25-35 | 5-12 |
| 66------------<br>Tice | 0-13 | Silty clay loam. | CL | A-6, A-7 | 0 | 0 | 100 | 100 | 90-100 | 80-95 | 30-45 | 10-20 |
| | 13-43 | Silty clay loam, silt loam. | CL, CH | A-7 | 0 | 0 | 100 | 100 | 95-100 | 85-95 | 40-55 | 15-30 |
| | 43-60 | Stratified silty clay loam to loam. | CL-ML, CL | A-4, A-6, A-7 | 0 | 0 | 100 | 100 | 60-95 | 55-80 | 25-45 | 5-20 |
| 67.<br>Aquents | | | | | | | | | | | | |
| 68------------<br>Bremer | 0-11 | Loam---------- | CL, ML | A-6, A-7 | 0 | 0 | 100 | 100 | 100 | 95-100 | 35-45 | 10-20 |
| | 11-60 | Silty clay loam, silty clay. | CH, MH | A-7 | 0 | 0 | 100 | 100 | 100 | 95-100 | 50-65 | 20-35 |
| 69------------<br>Floris | 0-13 | Silt loam----- | CL, ML, CL-ML | A-4 | 0 | 0 | 100 | 95-100 | 90-100 | 50-75 | <30 | 3-10 |
| | 13-60 | Loam, silt loam, silty clay loam. | CL, CL-ML | A-4, A-6 | 0 | 0 | 100 | 100 | 95-100 | 70-100 | 25-35 | 5-15 |

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

| Soil name and map symbol | Depth | Clay | Moist bulk density | Permeability | Available water capacity | Soil reaction | Shrink-swell potential | Erosion factors K | Erosion factors T | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | g/cc | In/hr | In/in | pH | | | | Pct |
| 14C2, 14D2-------- | 0-6 | 22-27 | 1.45-1.50 | 0.6-2.0 | 0.20-0.22 | 5.6-7.3 | Moderate----- | 0.32 | 3 | 2-3 |
| Armstrong | 6-41 | 36-60 | 1.45-1.55 | 0.06-0.2 | 0.11-0.16 | 4.5-6.5 | High--------- | 0.32 | | |
| | 41-60 | 30-36 | 1.55-1.70 | 0.2-0.6 | 0.14-0.16 | 5.1-7.8 | Moderate----- | 0.32 | | |
| 15C3, 15D3-------- | 0-4 | 35-42 | 1.45-1.50 | 0.2-0.6 | 0.18-0.20 | 5.6-7.3 | Moderate----- | 0.37 | 2 | 1-2 |
| Armstrong | 4-25 | 36-60 | 1.45-1.55 | 0.06-0.2 | 0.11-0.16 | 4.5-6.5 | High--------- | 0.32 | | |
| | 25-60 | 30-36 | 1.55-1.70 | 0.2-0.6 | 0.14-0.16 | 5.1-7.8 | Moderate----- | 0.32 | | |
| 16C2-------------- | 0-6 | 27-32 | 1.30-1.50 | 0.2-0.6 | 0.20-0.23 | 5.6-7.3 | Moderate----- | 0.37 | 3 | 2-4 |
| Bevier | 6-22 | 35-52 | 1.30-1.50 | 0.06-0.2 | 0.11-0.20 | 5.1-7.3 | High--------- | 0.28 | | |
| | 22-34 | 27-40 | 1.30-1.50 | 0.2-0.6 | 0.18-0.20 | 5.1-7.3 | High--------- | 0.32 | | |
| | 34-60 | 20-40 | 1.30-1.50 | 0.2-0.6 | 0.14-0.18 | 5.1-7.3 | High--------- | 0.32 | | |
| 17C, 17E, 17E2, 17F-------------- | 0-5 | 20-27 | 1.20-1.40 | 0.6-2.0 | 0.19-0.23 | 4.5-7.3 | Low---------- | 0.32 | 3 | 2-3 |
| Purdin | 5-10 | 30-40 | 1.35-1.55 | 0.2-0.6 | 0.12-0.16 | 4.5-6.5 | Moderate----- | 0.32 | | |
| | 10-25 | 35-45 | 1.35-1.55 | 0.06-0.2 | 0.10-0.16 | 4.5-6.5 | High--------- | 0.32 | | |
| | 25-40 | 35-45 | 1.35-1.55 | 0.06-0.2 | 0.10-0.16 | 7.4-8.4 | High--------- | 0.32 | | |
| | 40-60 | 24-35 | 1.40-1.60 | 0.2-0.6 | 0.12-0.17 | 7.4-8.4 | Moderate----- | 0.32 | | |
| 17F2-------------- | 0-5 | 27-35 | 1.20-1.40 | 0.2-0.6 | 0.16-0.18 | 4.5-7.3 | Moderate----- | 0.32 | 2 | .5-2 |
| Purdin | 5-27 | 35-45 | 1.35-1.55 | 0.06-0.2 | 0.10-0.16 | 4.5-6.5 | High--------- | 0.32 | | |
| | 27-44 | 35-45 | 1.35-1.55 | 0.06-0.2 | 0.10-0.16 | 7.4-8.4 | High--------- | 0.32 | | |
| | 44-60 | 24-35 | 1.40-1.60 | 0.2-0.6 | 0.12-0.17 | 7.4-8.4 | Moderate----- | 0.32 | | |
| 18C2-------------- | 0-5 | 12-30 | 1.30-1.50 | 0.6-2.0 | 0.22-0.24 | 5.1-7.3 | Moderate----- | 0.43 | 3 | .5-2 |
| Gorin | 5-8 | 27-42 | 1.30-1.45 | 0.06-0.6 | 0.18-0.20 | 4.5-6.5 | Moderate----- | 0.32 | | |
| | 8-24 | 35-60 | 1.30-1.40 | 0.06-0.2 | 0.11-0.16 | 4.5-6.0 | High--------- | 0.32 | | |
| | 24-45 | 27-40 | 1.30-1.45 | 0.2-0.6 | 0.18-0.20 | 4.5-6.5 | Moderate----- | 0.32 | | |
| | 45-60 | 20-27 | 1.30-1.45 | 0.2-0.6 | 0.17-0.20 | 4.5-6.5 | Moderate----- | 0.32 | | |
| 19E2-------------- | 0-12 | 18-27 | 1.30-1.40 | 0.2-0.6 | 0.18-0.20 | 5.1-6.5 | Low---------- | 0.43 | 3 | 1-2 |
| Gosport | 12-22 | 36-60 | 1.50-1.60 | <0.06 | 0.12-0.14 | 3.6-5.5 | High--------- | 0.32 | | |
| | 22-60 | --- | --- | <0.06 | --- | --- | ------------- | ---- | | |
| 22F--------------- | 0-7 | 18-27 | 1.30-1.40 | 0.2-0.6 | 0.18-0.20 | 6.1-8.4 | Low---------- | 0.37 | 3 | 1-2 |
| Vanmeter | 7-30 | 40-60 | 1.50-1.60 | <0.06 | 0.12-0.14 | 6.1-8.4 | High--------- | 0.32 | | |
| | 30-60 | --- | --- | <0.06 | --- | --- | ------------- | ---- | | |
| 23C2-------------- | 0-6 | 27-40 | 1.45-1.50 | 0.2-0.6 | 0.17-0.19 | 4.5-7.3 | Moderate----- | 0.37 | 3 | .5-2 |
| Keswick | 6-38 | 35-60 | 1.45-1.60 | 0.06-0.2 | 0.11-0.15 | 4.5-6.0 | High--------- | 0.37 | | |
| | 38-60 | 30-40 | 1.60-1.75 | 0.2-0.6 | 0.12-0.16 | 4.5-7.8 | Moderate----- | 0.37 | | |
| 23E3-------------- | 0-5 | 27-40 | 1.45-1.50 | 0.2-0.6 | 0.17-0.19 | 4.5-7.3 | Moderate----- | 0.37 | 2 | .5-2 |
| Keswick | 5-28 | 35-60 | 1.45-1.60 | 0.06-0.2 | 0.11-0.15 | 4.5-6.0 | High--------- | 0.37 | | |
| | 28-60 | 30-40 | 1.60-1.75 | 0.2-0.6 | 0.12-0.16 | 4.5-7.8 | Moderate----- | 0.37 | | |
| 26B2-------------- | 0-8 | 27-35 | 1.20-1.40 | 0.2-0.6 | 0.22-0.24 | 6.1-7.3 | Moderate----- | 0.37 | 3 | .5-2 |
| Leonard | 8-13 | 35-45 | 1.30-1.45 | 0.06-0.2 | 0.11-0.13 | 4.5-6.5 | High--------- | 0.37 | | |
| | 13-35 | 35-50 | 1.20-1.35 | 0.06-0.2 | 0.10-0.12 | 4.5-6.5 | High--------- | 0.37 | | |
| | 35-60 | 32-50 | 1.25-1.40 | 0.06-0.2 | 0.11-0.14 | 5.1-7.8 | High--------- | 0.37 | | |
| 27C, 27E2, 27F, 27F2------------- | 0-3 | 18-27 | 1.20-1.40 | 0.6-2.0 | 0.20-0.24 | 4.5-7.3 | Low---------- | 0.32 | 3 | .5-1 |
| Winnegan | 3-6 | 20-30 | 1.25-1.45 | 0.2-0.6 | 0.15-0.19 | 4.5-6.5 | Moderate----- | 0.32 | | |
| | 6-36 | 35-45 | 1.35-1.55 | 0.06-0.2 | 0.09-0.15 | 4.5-6.5 | High--------- | 0.32 | | |
| | 36-49 | 35-45 | 1.35-1.55 | 0.06-0.2 | 0.09-0.15 | 7.4-8.4 | High--------- | 0.32 | | |
| | 49-60 | 20-35 | 1.40-1.60 | 0.2-0.6 | 0.09-0.15 | 7.4-8.4 | Moderate----- | 0.32 | | |

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth | Clay | Moist bulk density | Permeability | Available water capacity | Soil reaction | Shrink-swell potential | Erosion factors K | Erosion factors T | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | g/cc | In/hr | In/in | pH | | | | Pct |
| 30B-------------- Mexico | 0-11 | 15-27 | 1.20-1.40 | 0.6-2.0 | 0.22-0.24 | 5.1-7.3 | Low---------- | 0.43 | 3 | 2-4 |
| | 11-15 | 35-50 | 1.25-1.45 | 0.2-0.6 | 0.12-0.16 | 4.5-6.0 | High--------- | 0.32 | | |
| | 15-36 | 50-60 | 1.25-1.45 | <0.06 | 0.08-0.12 | 4.5-6.0 | High--------- | 0.32 | | |
| | 36-53 | 35-50 | 1.25-1.45 | 0.2-0.6 | 0.12-0.16 | 5.1-7.3 | High--------- | 0.32 | | |
| | 53-60 | 27-50 | 1.25-1.45 | <0.6 | 0.12-0.18 | 5.1-7.3 | High--------- | 0.32 | | |
| 31--------------- Putnam | 0-9 | 12-27 | 1.30-1.45 | 0.6-2.0 | 0.22-0.24 | 4.5-7.3 | Low---------- | 0.43 | 3 | .5-3 |
| | 9-16 | 12-27 | 1.30-1.50 | 0.6-2.0 | 0.20-0.22 | 4.5-6.5 | Low---------- | 0.43 | | |
| | 16-31 | 48-60 | 1.20-1.40 | <0.06 | 0.09-0.11 | 3.6-5.5 | High--------- | 0.28 | | |
| | 31-45 | 35-48 | 1.25-1.45 | 0.06-0.2 | 0.12-0.16 | 3.6-5.5 | High--------- | 0.37 | | |
| | 45-60 | 27-35 | 1.30-1.50 | 0.06-0.2 | 0.14-0.18 | 5.1-6.5 | Moderate----- | 0.43 | | |
| 32B, 32B2-------- Adco | 0-8 | 15-30 | 1.20-1.40 | 0.6-2.0 | 0.20-0.24 | 4.5-7.3 | Low---------- | 0.32 | 3 | 1-4 |
| | 8-12 | 15-30 | 1.20-1.40 | 0.6-2.0 | 0.16-0.20 | 4.5-6.5 | Low---------- | 0.32 | | |
| | 12-23 | 50-60 | 1.20-1.40 | <0.06 | 0.09-0.11 | 5.1-6.5 | High--------- | 0.43 | | |
| | 23-46 | 32-50 | 1.25-1.45 | 0.06-0.2 | 0.12-0.18 | 5.1-7.3 | High--------- | 0.43 | | |
| | 46-60 | 15-35 | 1.30-1.50 | 0.06-0.2 | 0.14-0.18 | 5.6-7.3 | Moderate----- | 0.43 | | |
| 40--------------- Vesser | 0-12 | 20-26 | 1.30-1.35 | 0.6-2.0 | 0.20-0.24 | 5.6-7.3 | Moderate----- | 0.28 | 5 | 2-3 |
| | 12-24 | 18-22 | 1.35-1.40 | 0.6-2.0 | 0.18-0.22 | 5.1-6.0 | Moderate----- | 0.43 | | |
| | 24-60 | 30-35 | 1.40-1.45 | 0.6-2.0 | 0.17-0.21 | 5.1-6.5 | Moderate----- | 0.43 | | |
| 41B-------------- Marion | 0-18 | 12-27 | 1.30-1.45 | 0.6-2.0 | 0.22-0.24 | 4.5-7.3 | Low---------- | 0.43 | 3 | .5-2 |
| | 18-36 | 48-60 | 1.30-1.65 | <0.06 | 0.11-0.13 | 3.6-5.5 | High--------- | 0.32 | | |
| | 36-60 | 30-40 | 1.30-1.55 | 0.06-0.2 | 0.15-0.17 | 3.6-6.0 | Moderate----- | 0.43 | | |
| 42--------------- Bremer | 0-18 | 22-27 | 1.25-1.30 | 0.6-2.0 | 0.21-0.25 | 5.6-7.3 | Moderate----- | 0.32 | 5 | 3-5 |
| | 18-44 | 35-42 | 1.30-1.40 | 0.2-0.6 | 0.15-0.17 | 5.6-6.5 | High--------- | 0.43 | | |
| | 44-60 | 32-38 | 1.40-1.45 | 0.2-0.6 | 0.18-0.20 | 5.6-6.5 | High--------- | 0.43 | | |
| 43--------------- Chariton | 0-9 | 18-27 | 1.35-1.50 | 0.6-2.0 | 0.22-0.24 | 5.1-7.3 | Low---------- | 0.37 | 3 | 1-4 |
| | 9-15 | 15-24 | 1.35-1.50 | 0.6-2.0 | 0.20-0.22 | 5.1-6.5 | Low---------- | 0.37 | | |
| | 15-18 | 27-32 | 1.35-1.45 | 0.2-0.6 | 0.18-0.20 | 5.1-6.0 | Moderate----- | 0.37 | | |
| | 18-37 | 48-60 | 1.35-1.45 | 0.06-0.2 | 0.11-0.13 | 5.1-7.3 | High--------- | 0.28 | | |
| | 37-46 | 32-40 | 1.35-1.45 | 0.2-0.6 | 0.18-0.20 | 6.1-7.8 | Moderate----- | 0.43 | | |
| | 46-60 | 15-35 | 1.40-1.55 | 0.6-2.0 | 0.15-0.18 | 6.1-7.8 | Moderate----- | 0.32 | | |
| 44B-------------- Gifford | 0-7 | 20-27 | 1.30-1.45 | 0.6-2.0 | 0.22-0.24 | 5.1-7.3 | Low---------- | 0.43 | 3 | 1-4 |
| | 7-10 | 27-35 | 1.30-1.45 | 0.2-0.6 | 0.18-0.20 | 5.1-6.5 | Low---------- | 0.43 | | |
| | 10-39 | 35-50 | 1.30-1.45 | <0.06 | 0.11-0.14 | 5.1-7.3 | High--------- | 0.32 | | |
| | 39-60 | 25-35 | 1.35-1.50 | 0.06-0.2 | 0.18-0.20 | 5.6-7.3 | Moderate----- | 0.43 | | |
| 44C2------------- Gifford | 0-5 | 20-27 | 1.30-1.45 | 0.6-2.0 | 0.22-0.24 | 5.1-7.3 | Low---------- | 0.43 | 3 | 1-4 |
| | 5-10 | 35-50 | 1.30-1.45 | <0.06 | 0.11-0.14 | 5.1-7.3 | High--------- | 0.32 | | |
| | 10-33 | 25-35 | 1.35-1.50 | 0.06-0.2 | 0.18-0.20 | 5.6-7.3 | Moderate----- | 0.43 | | |
| | 33-60 | 18-27 | 1.30-1.45 | 0.2-0.6 | 0.20-0.22 | 5.6-7.3 | Low---------- | 0.43 | | |
| 45A-------------- Moniteau | 0-9 | 18-27 | 1.20-1.40 | 0.6-2.0 | 0.21-0.23 | 6.1-7.3 | Low---------- | 0.43 | 5 | 1-2 |
| | 9-22 | 18-27 | 1.20-1.40 | 0.6-2.0 | 0.20-0.22 | 5.1-7.3 | Low---------- | 0.43 | | |
| | 22-60 | 27-35 | 1.30-1.50 | 0.2-0.6 | 0.18-0.20 | 4.5-6.0 | Moderate----- | 0.43 | | |
| 46B-------------- Vigar | 0-20 | 15-27 | 1.25-1.45 | 0.6-2.0 | 0.20-0.22 | 5.6-7.3 | Low---------- | 0.24 | 5 | 2-4 |
| | 20-60 | 24-35 | 1.20-1.40 | 0.2-0.6 | 0.14-0.16 | 5.6-7.3 | Moderate----- | 0.32 | | |
| 51--------------- Wilbur | 0-8 | 10-17 | 1.30-1.45 | 0.6-2.0 | 0.22-0.24 | 5.6-7.3 | Low---------- | 0.37 | 5 | 1-2 |
| | 8-60 | 10-17 | 1.30-1.45 | 0.6-2.0 | 0.20-0.22 | 5.6-7.3 | Low---------- | 0.37 | | |
| 52--------------- Blackoar | 0-16 | 18-27 | 1.35-1.45 | 0.6-2.0 | 0.20-0.24 | 5.6-7.3 | Low---------- | 0.28 | 5 | 2-4 |
| | 16-42 | 18-27 | 1.35-1.45 | 0.6-2.0 | 0.20-0.22 | 5.6-7.3 | Low---------- | 0.43 | | |
| | 42-60 | 18-30 | 1.35-1.45 | 0.6-2.0 | 0.18-0.22 | 5.6-7.3 | Low---------- | 0.43 | | |
| 53--------------- Chequest | 0-10 | 30-35 | 1.30-1.35 | 0.2-0.6 | 0.18-0.20 | 5.1-7.3 | High--------- | 0.32 | 5 | 3-4 |
| | 10-60 | 35-42 | 1.35-1.45 | 0.2-0.6 | 0.14-0.18 | 5.1-6.0 | High--------- | 0.43 | | |

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Soil name and map symbol | Depth | Clay | Moist bulk density | Permeability | Available water capacity | Soil reaction | Shrink-swell potential | Erosion factors K | Erosion factors T | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | g/cc | In/hr | In/in | pH | | | | Pct |
| 55---------------Piopolis | 0-9 | 27-35 | 1.20-1.40 | 0.06-0.2 | 0.21-0.23 | 5.1-6.5 | Moderate----- | 0.43 | 5 | 1-2 |
| | 9-42 | 27-35 | 1.40-1.60 | 0.06-0.2 | 0.18-0.20 | 4.5-5.5 | Moderate----- | 0.43 | | |
| | 42-60 | 25-38 | 1.50-1.70 | 0.06-0.2 | 0.18-0.20 | 5.1-7.3 | Moderate----- | 0.43 | | |
| 56---------------Darwin | 0-11 | 40-45 | 1.20-1.40 | <0.06 | 0.11-0.14 | 6.1-7.8 | Very high---- | 0.28 | 5 | 4-5 |
| | 11-45 | 45-60 | 1.30-1.50 | <0.06 | 0.11-0.14 | 6.1-7.8 | Very high---- | 0.28 | | |
| | 45-60 | 30-55 | 1.40-1.60 | 0.06-0.2 | 0.10-0.20 | 6.6-8.4 | High--------- | 0.28 | | |
| 57---------------Floris | 0-13 | 10-18 | 1.25-1.30 | 2.0-6.0 | 0.20-0.22 | 6.1-7.3 | Low---------- | 0.32 | 5 | 1-2 |
| | 13-30 | 5-18 | 1.25-1.35 | 2.0-6.0 | 0.13-0.18 | 6.1-7.3 | Low---------- | 0.20 | | |
| | 30-60 | 18-38 | 1.25-1.35 | 0.6-2.0 | 0.20-0.23 | 6.1-7.3 | Moderate----- | 0.43 | | |
| 58---------------Excello | 0-13 | 18-27 | 1.35-1.45 | 0.6-2.0 | 0.22-0.24 | 6.1-7.3 | Moderate----- | 0.28 | 5 | 2-4 |
| | 13-43 | 18-35 | 1.40-1.60 | 0.6-2.0 | 0.15-0.19 | 6.1-7.3 | Moderate----- | 0.28 | | |
| | 43-60 | 18-35 | 1.50-1.65 | 0.6-2.0 | 0.14-0.19 | 6.1-7.3 | Moderate----- | 0.28 | | |
| 60E, 60F---------Lenzburg | 0-3 | 27-35 | 1.30-1.60 | 0.6-2.0 | 0.17-0.22 | 6.6-8.4 | Moderate----- | 0.37 | 5 | <0.5 |
| | 3-60 | 20-35 | 1.30-1.60 | 0.2-0.6 | 0.15-0.18 | 6.6-8.4 | Moderate----- | 0.37 | | |
| 63B--------------Zook | 0-12 | 35-40 | 1.30-1.35 | 0.2-0.6 | 0.21-0.23 | 5.6-7.3 | High--------- | 0.28 | 5 | 4-7 |
| | 12-50 | 35-45 | 1.30-1.45 | 0.06-0.2 | 0.11-0.13 | 5.6-7.3 | High--------- | 0.28 | | |
| | 50-60 | 25-45 | 1.30-1.45 | 0.06-0.2 | 0.11-0.20 | 5.6-7.3 | High--------- | 0.28 | | |
| 65---------------Dockery | 0-8 | 15-27 | 1.35-1.45 | 0.6-2.0 | 0.22-0.24 | 5.6-7.3 | Low---------- | 0.37 | 5 | 2-4 |
| | 8-36 | 18-30 | 1.35-1.45 | 0.6-2.0 | 0.20-0.24 | 5.6-7.8 | Moderate----- | 0.37 | | |
| | 36-60 | 15-27 | 1.35-1.45 | 0.6-2.0 | 0.12-0.20 | 5.6-7.3 | Moderate----- | 0.37 | | |
| 66---------------Tice | 0-13 | 27-35 | 1.25-1.45 | 0.6-2.0 | 0.21-0.24 | 6.1-7.8 | Moderate----- | 0.32 | 5 | 2-3 |
| | 13-43 | 27-35 | 1.30-1.50 | 0.6-2.0 | 0.18-0.20 | 5.6-7.8 | Moderate----- | 0.32 | | |
| | 43-60 | 15-30 | 1.40-1.60 | 0.6-2.0 | 0.11-0.18 | 5.6-7.8 | Moderate----- | 0.32 | | |
| 67. Aquents | | | | | | | | | | |
| 68---------------Bremer | 0-11 | 22-27 | 1.25-1.30 | 0.6-2.0 | 0.21-0.25 | 5.6-7.3 | Moderate----- | 0.32 | 5 | 3-5 |
| | 11-60 | 35-42 | 1.30-1.40 | 0.2-0.6 | 0.15-0.17 | 5.6-6.5 | High--------- | 0.43 | | |
| 69---------------Floris | 0-13 | 10-18 | 1.25-1.30 | 2.0-6.0 | 0.20-0.22 | 6.1-7.3 | Low---------- | 0.32 | 5 | 1-2 |
| | 13-60 | 18-38 | 1.25-1.35 | 0.6-2.0 | 0.20-0.23 | 6.1-7.3 | Moderate----- | 0.43 | | |

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

| Soil name and map symbol | Hydro-logic group | Flooding | | | High water table | | | Bedrock | | Potential frost action | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | | | |
| 14C2, 14D2, 15C3, 15D3: Armstrong | C | None | --- | --- | 1.0-3.0 | Perched | Nov-May | >60 | --- | High | High | Moderate. |
| 16C2: Bevier | C | None | --- | --- | 2.0-4.0 | Perched | Nov-May | >60 | --- | High | High | Moderate. |
| 17C, 17E, 17E2, 17F, 17F2: Purdin | C | None | --- | --- | 2.0-3.5 | Perched | Nov-Apr | >60 | --- | Moderate | High | High. |
| 18C2: Gorin | C | None | --- | --- | 2.0-4.0 | Perched | Nov-Apr | >60 | --- | High | High | Moderate. |
| 19E2: Gosport | C | None | --- | --- | >6.0 | --- | --- | 20-40 | Soft | Moderate | High | High. |
| 22F: Vanmeter | C | None | --- | --- | >6.0 | --- | --- | 20-40 | Soft | Moderate | High | Low. |
| 23C2, 23E3: Keswick | C | None | --- | --- | 1.0-3.0 | Perched | Nov-May | >60 | --- | High | High | Moderate. |
| 26B2: Leonard | D | None | --- | --- | 0.5-2.0 | Perched | Nov-May | >60 | --- | High | High | Moderate. |
| 27C, 27E2, 27F, 27F2: Winnegan | C | None | --- | --- | 2.0-3.5 | Perched | Nov-Apr | >60 | --- | Moderate | High | High. |
| 30B: Mexico | D | None | --- | --- | 1.0-2.5 | Perched | Nov-May | >60 | --- | Moderate | High | Moderate. |
| 31: Putnam | D | None | --- | --- | 0.5-1.5 | Perched | Nov-May | >60 | --- | Moderate | High | High. |
| 32B, 32B2: Adco | D | None | --- | --- | 2.0-4.0 | Perched | Nov-May | >60 | --- | High | High | Moderate. |
| 40: Vesser | C | Occasional | Brief | Nov-May | 1.0-3.0 | Apparent | Nov-May | >60 | --- | High | High | Moderate. |

TABLE 17.--SOIL AND WATER FEATURES--Continued

| Soil name and map symbol | Hydrologic group | Flooding: Frequency | Flooding: Duration | Flooding: Months | High water table: Depth | High water table: Kind | High water table: Months | Bedrock: Depth | Bedrock: Hardness | Potential frost action | Risk of corrosion: Uncoated steel | Risk of corrosion: Concrete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ft | | | In | | | | |
| 41B---------------- Marion | D | None--------- | --- | --- | 1.0-2.0 | Perched | Nov-May | >60 | --- | Moderate | High----- | High. |
| 42---------------- Bremer | C | Rare--------- | --- | --- | 1.0-2.0 | Apparent | Nov-May | >60 | --- | High----- | Moderate | Moderate. |
| 43---------------- Chariton | C | None--------- | --- | --- | 0-1.5 | Perched | Nov-May | >60 | --- | High----- | High----- | Moderate. |
| 44B, 44C2--------- Gifford | D | None--------- | --- | --- | 0.5-2.0 | Perched | Nov-May | >60 | --- | Moderate | High----- | Moderate. |
| 45A---------------- Moniteau | C/D | Occasional | Brief----- | Nov-May | 0-1.0 | Apparent | Nov-May | >60 | --- | High----- | High----- | High. |
| 46B---------------- Vigar | C | Rare--------- | --- | --- | 2.0-3.0 | Apparent | Nov-Apr | >60 | --- | High----- | High----- | Moderate. |
| 51---------------- Wilbur | B | Frequent---- | Brief----- | Nov-May | 1.5-3.0 | Apparent | Nov-Apr | >60 | --- | High----- | Moderate | Moderate. |
| 52---------------- Blackoar | B/D | Frequent---- | Brief----- | Nov-May | 0-1.0 | Apparent | Nov-May | >60 | --- | High----- | High----- | Low. |
| 53---------------- Chequest | C | Occasional | Brief----- | Nov-May | 1.0-3.0 | Apparent | Nov-Jun | >60 | --- | High----- | High----- | Moderate. |
| 55---------------- Piopolis | C/D | Frequent---- | Brief----- | Nov-May | 0-3.0 | Apparent | Nov-Jun | >60 | --- | High----- | High----- | Moderate. |
| 56---------------- Darwin | D | Occasional | Brief----- | Nov-May | +1-2.0 | Apparent | Nov-Jun | >60 | --- | Moderate | High----- | Low. |
| 57---------------- Floris | B | Frequent---- | Brief----- | Nov-May | 3.0-5.0 | Apparent | Nov-Jun | >60 | --- | Moderate | Low------ | Moderate. |
| 58---------------- Excello | B/D | Frequent---- | Brief----- | Nov-May | 1.0-3.0 | Apparent | Nov-May | >60 | --- | High----- | High----- | Low. |
| 60E, 60F---------- Lenzburg | B | None--------- | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Moderate | Low. |
| 63B---------------- Zook | C | Occasional | Brief----- | Nov-May | 0-2.0 | Apparent | Nov-May | >60 | --- | High----- | High----- | Moderate. |

TABLE 17.--SOIL AND WATER FEATURES--Continued

| Soil name and map symbol | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Potential frost action | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | | | |
| 65----------------<br>Dockery | C | Occasional | Brief----- | Nov-May | 2.0-3.0 | Apparent | Nov-Apr | >60 | --- | High----- | Moderate | Low. |
| 66----------------<br>Tice | B | Frequent---- | Brief----- | Nov-May | 1.5-3.0 | Apparent | Nov-May | >60 | --- | High----- | High----- | Low. |
| 67----------------<br>Aquents | C | Frequent---- | Long------ | Jan-Dec | +3-1.0 | Apparent | Sep-Jul | >60 | --- | --------- | --------- | --- |
| 68----------------<br>Bremer | C | Occasional | Very brief | Nov-May | 1.0-2.0 | Apparent | Nov-May | >60 | --- | High----- | Moderate | Moderate. |
| 69----------------<br>Floris | B | Occasional | Very brief or brief. | Nov-May | 3.0-5.0 | Apparent | Nov-Apr | >60 | --- | Moderate | Low------ | Moderate. |

TABLE 18.--CLASSIFICATION OF THE SOILS

| Soil name | Family or higher taxonomic class |
|---|---|
| Adco | Fine, montmorillonitic, mesic Albaquic Hapludalfs |
| Aquents | Typic Fluvaquents |
| Armstrong | Fine, montmorillonitic, mesic Aquollic Hapludalfs |
| Bevier | Fine, montmorillonitic, mesic Aquollic Hapludalfs |
| Blackoar | Fine-silty, mixed, mesic Fluvaquentic Haplaquolls |
| Bremer | Fine, montmorillonitic, mesic Typic Argiaquolls |
| Chariton | Fine, montmorillonitic, mesic Mollic Albaqualfs |
| Chequest | Fine, montmorillonitic, mesic Typic Haplaquolls |
| Darwin | Fine, montmorillonitic, mesic Vertic Haplaquolls |
| Dockery | Fine-silty, mixed, nonacid, mesic Aquic Udifluvents |
| Excello | Fine-loamy, mixed, mesic Cumulic Haplaquolls |
| Floris | Coarse-loamy, mixed, nonacid, mesic Typic Udifluvents |
| Gifford | Fine, montmorillonitic, mesic Vertic Ochraqualfs |
| Gorin | Fine, montmorillonitic, mesic Aquic Hapludalfs |
| Gosport | Fine, illitic, mesic Typic Dystrochrepts |
| Keswick | Fine, montmorillonitic, mesic Aquic Hapludalfs |
| Lenzburg | Fine-loamy, mixed (calcareous), mesic Typic Udorthents |
| Leonard | Fine, montmorillonitic, mesic, sloping Vertic Ochraqualfs |
| Marion | Fine, montmorillonitic, mesic Albaquic Hapludalfs |
| Mexico | Fine, montmorillonitic, mesic Udollic Ochraqualfs |
| Moniteau | Fine-silty, mixed, mesic Typic Ochraqualfs |
| Piopolis | Fine-silty, mixed, acid, mesic Typic Fluvaquents |
| Purdin | Fine, mixed, mesic Mollic Hapludalfs |
| Putnam | Fine, montmorillonitic, mesic Mollic Albaqualfs |
| Tice | Fine-silty, mixed, mesic Fluvaquentic Hapludolls |
| Vanmeter | Fine, illitic, mesic Typic Eutrochrepts |
| Vesser | Fine-silty, mixed, mesic Argiaquic Argialbolls |
| Vigar | Fine-loamy, mixed, mesic Aquic Argiudolls |
| Wilbur | Coarse-silty, mixed, nonacid, mesic Aquic Udifluvents |
| Winnegan | Fine, mixed, mesic Typic Hapludalfs |
| Zook | Fine, montmorillonitic, mesic Cumulic Haplaquolls |

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